Radio and Electrical Review

VOL. 11, No. 12 FEBRUARY 1st, 1957

OUR COVER: Ship and aircraft spotting from the coast. The photograph shows a Marconi 20 kw. 3 cm. surveillance radar installed on a coastal site for operational tests. This set has a special power-tilting scanner, and a switch polarizer grid in the aerial system which enable a fairly high degree of discrimination against sea returns to be obtained.

Official Journal of
The New Zealand Electronics Institute (Inc.).
The New Zealand Radio and Television Manufacturers' Federation.
The New Zealand Radio and Electrical Traders' Federation.
New Zealand Radio, TV, and Electrical Traders' Association (Inc.).

Managing and Technical Director:
W. D. FOSTER, B.Sc.

Subscriptions:
2s. 3d. per copy; 27s. per annum, posted.
Advertising Rates supplied on application.

CORRESPONDENCE
All correspondence and contributions should be addressed to:
The Editor,
"Radio and Electrical Review",
P.O. Box 6361,
Wellington, New Zealand.

OFFICES AND LABORATORY:
Radio and Electronics (N.Z.) Ltd.,
48 Abel Smith Street, Wellington.
Telephone, Wellington, 50-660.
Telegrams and Cables:
"Radel", Wellington.

SOLE ADVERTISING REPRESENTATIVES for THE UNITED KINGDOM:
Cowlishaw and Lawrence (Advertising), Ltd., P.O. Box 656, 14–16 Ludgate Hill, London, E.C.4. Telephones: City 3718.
Cables: Cowlawads, London.

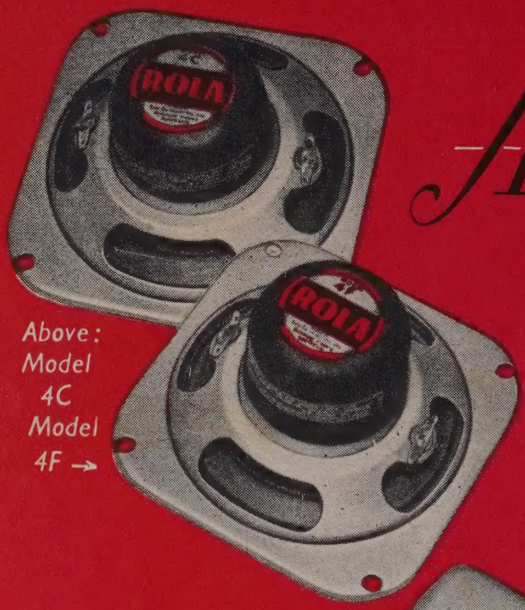
Contents

	Page
Editorial	17
A High-quality Audio Amplifier with a Difference	18
Junction Transistors as Oscillators	24
The Philips Experimenter: No. 109: Some New Philips Transistors	28
Interpretation of Vacuum-tube Ratings	31
World TV Developments	33
The Importance of Ionospheric Scatter	34
Record Talk, by John Gray	35
Commencement of Electrical and Trade Section	37
TV or Not TV? An Estimate of Costs	37
Trade Winds	39
New Products: Latest Releases in Electrical and Electronic Equipment	43
Around and About	44
Missing and Stolen Radios	45
For the Serviceman: The "Editor" Model A13 Tape Recorder (concluded)	49

Sole New Zealand Distributors: Gordon & Gotch (N.Z.) Ltd., Wellington

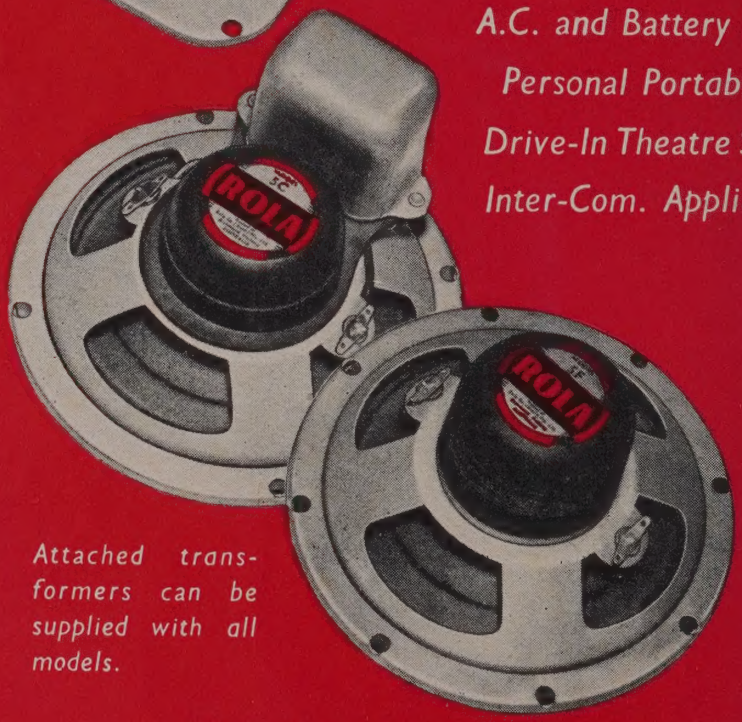
PRINTED BY HARRY H. TOMBS LTD., WINGFIELD STREET, WELLINGTON

A new Range of ROLA MIDGET MODELS for...



Above:
Model 4C
Model 4F →

A.C. and Battery Models
Personal Portables
Drive-In Theatre Systems
Inter-Com. Applications



Model 5C

Model 5F

Attached transformers can be supplied with all models.

Full Technical Details From:

ARNOLD & WRIGHT LTD., WELLINGTON, CHRISTCHURCH, DUNEDIN, AUCKLAND

BELLING and LEE LTD
ENGLAND

Components, Aerials and Filters for the Electronic and Electrical Trade

- TERMINALS
- FLEXIBLE TERMINAL BLOCKS
- COAXIAL PLUGS and SOCKETS
- MINIATURE THERMAL PROTECTION DEVICES
- FUSES and FUSEHOLDERS
- INTERFERENCE FILTERS
- HOUSEHOLD-TYPE AERIALS

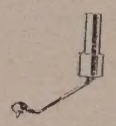
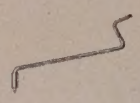
The Sign of Dependable Components

FULL STOCKS AVAILABLE FROM SOLE NEW ZEALAND AGENTS:

TURNBULL and JONES LTD

AUCKLAND : HAMILTON : PALMERSTON NORTH : WELLINGTON : NELSON
CHRISTCHURCH : DUNEDIN : INVERCARGILL

acos REPLACEMENT STYLI

CODE			RETAIL PRICE
SA-1 and SA-2		SA-1: For standard 78 r.p.m. records. Use with Acos G.P.15 and G.P.27 standard cartridges. SA-2: For microgroove 33/45 r.p.m. records. Use with Acos G.P.15 and G.P.27 microgroove cartridges. (See note below)	8/- each
SB-1 and SB-2		SB-1: For standard 78 r.p.m. records. Use with Acos G.P.19 series* H.G.P.35, H.G.P.39, H.G.P.45 cartridges and with G.P.20 series pick-ups. SB-2: For microgroove 33/45 r.p.m. records. Use with microgroove versions of the above cartridges and pick-ups.	8/- each
SC-1 and SC-2		SC-1: For standard 78 r.p.m. records. SC-2: For microgroove 33/45 records. Use with Acos G.P.25 and G.P.29 series turnover cartridges and with Acos G.P.30 pick-up.	8/- each
SE-1 and SE-2		SE-1: For standard 78 r.p.m. records. SE-2: For microgroove 33/45 r.p.m. records. Use with Acos H.G.P.37 series turnover cartridges and with Acos H.G.P.37/Garrard and H.G.P.37/Collaro replacement pick-up heads.	8/- each

*The G.P.19 cartridge should be returned to Cosmocord Ltd. for sapphire replacement.

N.B.—The G.P.15 is supplied with standard or long-playing stylus. Messrs. Plessey fit their own forked stylus incorporating two sapphire points.

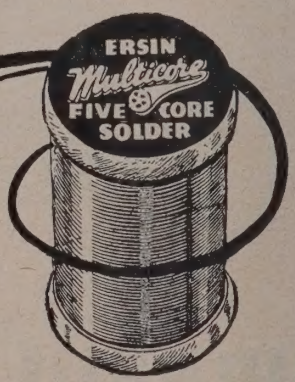
SOLE NEW ZEALAND AGENTS

DAVID J. REID (N.Z.) LTD.

P.O. BOX 2630 — 271 VICTORIA STREET WEST, AUCKLAND. — TEL. 30-832

"the finest cored solder in the World"

ERSIN MULTICORE SOLDER

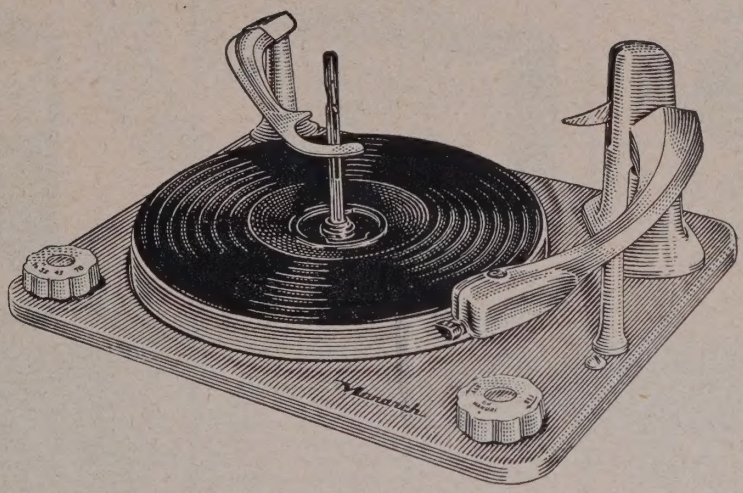


Available ex-stock in a range of gauges and alloys to meet all requirements

GE1.6

New Zealand Distributors: GILES & ELLIOTT LTD. Wellington, Auckland, Christchurch, Dunedin.
Also available from all branches of Turnbull & Jones Ltd.

WORLD'S FINEST 4 SPEED AUTOCHANGER



STANDARD EQUIPMENT FOR ALL LEADING RADIOGRAMS AND RECORD PLAYERS

★*Plays ten* 12 in., 10 in., *or* 7 in. *records at* 78, 45, *or* 35 *r.p.m.—and the new* 16 *r.p.m. records.* ★*Intermixes ten* 7 in., 10 in., *and* 12 in. *records of the same speed.* ★*Manual play position for playing single records.*

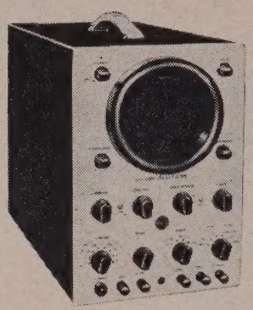
★*High-fidelity "ACOS" crystal Cartridge with dual sapphire styli.* ★*Exquisitely styled—in a two-toned finish.*

Monarch

Manufactured by Birmingham BSR Sound Reproducers Ltd., England

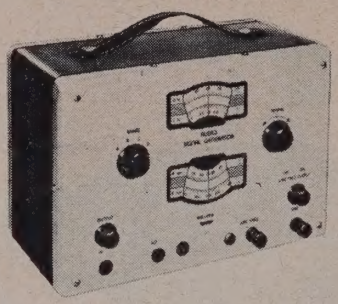
Sole N.Z. Agents: DAVID J. REID (N.Z.) LTD., Box 2630, Auckland

FULL RANGE R.C.A. TESTING EQUIPMENT NOW AVAILABLE IN NEW ZEALAND!



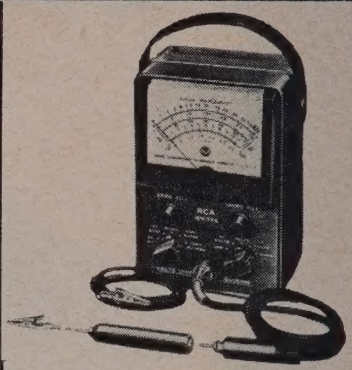
5 in. OSCILLOSCOPE WO-88A

Built in voltage calibrating facilities permit simultaneous wave shape display and peak-to-peak voltage measurements. Sync polarity instantly reversible via front panel switch. Matched high impedance probe provides overall input resistance of 10 megohms and input capacitance of not less than 10 mmfd. Response is flat within —3 db from 0–500 Kc, useful to 1.0 Mc.



AUDIO SIGNAL GENERATOR WA-44A

Excellent for use in measuring impedances of amplifiers; resonant intermodulation distortion in frequency response; input and output frequency of loudspeakers; and speed of recorder/reproducer mechanisms, etc. The WA-44A features a new RC-type oscillator having wide frequency range and an amplified agc circuit ensures an output within ± 1 db over the entire frequency range.

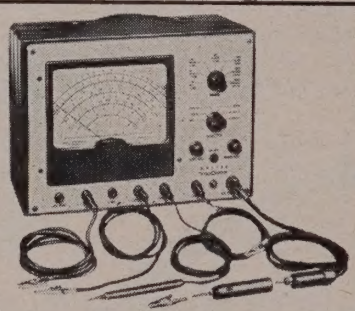


JUNIOR VOLTOHMYST WV-77A

Unquestionably the greatest value in all-electronic AC-operated vacuum-tube voltohmmeters. Features include: High-input resistance, low-input capacitance on DC functions, ability to measure DC in the presence of AC and vice versa, burn-out-proof meter circuit, ± 1% multiplier resistors, DC polarity reversing switch, negative feedback bridge circuit, etc. Plus wide frequency response and extended voltage ranges.

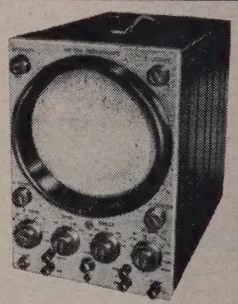
SENIOR VOLTOHMYST WV-97A

Contains full-wave signal rectifier for direct readings of peak-to-peak voltages up to 4200 volts. Measures DC voltage from 0.02 volts to 1500 volts with accuracy of ± 3% of full scale. Has 11 megohm input resistance, electronic protection against meter burn-out, zero-centre scale, rugged 200-microampere meter movement, ± 1% multiplier resistors.



MASTER VOLTOHMYST WV-87A

Featuring a 7½ in. meter, the WV-87A measures DC voltages accurately in high-impedance circuits, even with AC present. It also reads rms values of sine waves and the peak-to-peak values of complex waves or recurrent pulses, even in the presence of DC. Other features include: ± 1% multiplier and shunt resistors, a ± 2% meter movement, DC polarity reversing switch, etc. Accurate and stable enough for many laboratory applications.



7 in. OSCILLOSCOPE WO-56A

7 in. screen plus trace expansion of 3 times screen diameter provide unusually large wave-shape display for distant viewing or examination of minute portion of wave shapes. Identical frequency and phase characteristics of both the V and H amplifiers make the WO-56A invaluable for phase measurements. Frequency compensated and voltage calibrated attenuators on both amplifiers. Response is flat within —2 db from DC to 500 Kc, within —6 db at 1 Mc.

New Zealand Distributors:

AMALGAMATED WIRELESS (AUSTRALASIA) LIMITED

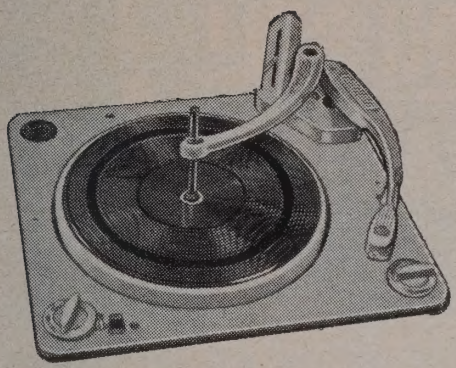
P.O. Box 830, Wellington —— P.O. Box 1363, Auckland —— P.O. Box 2084 Christchurch

CASH IN ON

COLLARO

QUALITY AT LOW COST

Their obvious quality, their high degree of performance, combined with economy of price, make Collaro a best-selling name in sound reproduction. Stock Collaro — profit from Collaro!



COLLARO RC "456"

4-speed auto-record changer with manual play facility for single records. A brilliant new product with instant sales appeal.

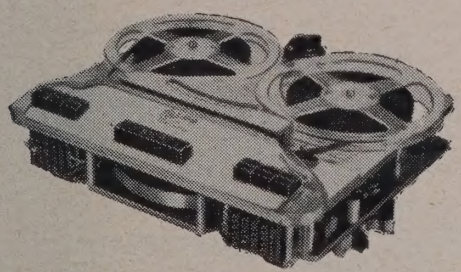
Price: £13 19s. 6d.

COLLARO 2010 TRANSCRIPTION UNIT

Offers really high-fidelity at low cost. The instrument for the critical listener. Equipped with a "Studio" PX high-fidelity pick-up

£20 4s.

(Without pick-up) £15 8s. 6d.

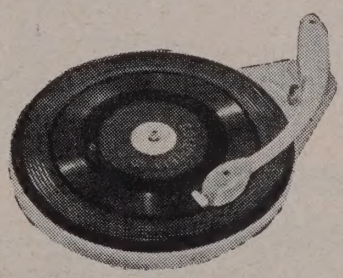


COLLARO HIGH-FIDELITY TAPE TRANSCRIPTOR

A reasonably priced high-fidelity, tape transcriptor which includes more refinements than incorporated in other tape decks. You won't need to "hard-sell" this one at

£29 15s.

COLLARO 4/564



A new 4-speed Collaro player with automatic cut-off. Incorporates all the quality features for excellent reproduction. A ready seller at

£8 8s.

(All Prices Retail)

For full information on these models, write to the New Zealand Distributors:

RUSSELL IMPORT CO. LTD.

P. O. BOX 9038 — AUCKLAND P.O. BOX 102 — WELLINGTON P.O. BOX 1871 — CHRISTCHURCH

HOW BELL HELPS YOU SELL MORE RADIOS

FREE
NEWSPAPER BLOCKS
available in sizes to suit your advertising requirements

FREE
RADIO COPY
featuring your name and address

FREE
SCREEN SLIDES
for all models—supplied complete with your firm's name and address

FREE
SHOWCARDS
to help you with your own point-of-sale displays

FREE
PRICE TICKETS
issued with each model as it is released

ADDITIONAL PULLS
of all advertisements, supplied in quantity. Suitable for your local mailings or for shop distribution

WITH NATION-WIDE ADVERTISING

Through metropolitan and provincial newspapers, through the national network of commercial radio, BELL reaches customers in every corner of New Zealand. Four days every week, over 200,000 homes hear BELL announcements. Every month, BELL newspaper advertisements are looked at nearly 1½ million times. The name BELL is no stranger to the customer when he enters your door.

WITH EXTRA SERVICES TO YOU

Bell's 'Dealer Service' Plan helps you sell more radios and saves you **real** money at the same time. Shown at left are some of the ways you benefit.

WRITE NOW FOR FREE MATERIAL

BELL Radio

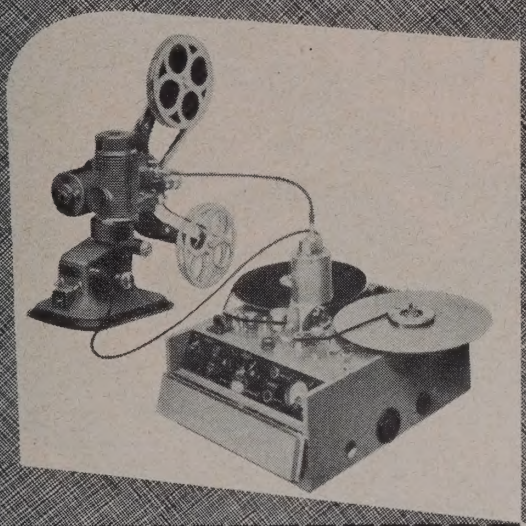
BELL RADIO-TELEVISION CORP. LTD.,
274 Dominion Road. Auckland

Sell MORE radios, make MORE satisfied customers—write NOW for your requirements DIRECT to BELL DEALER SERVICE, CASSRELS ADVERTISING LTD., P.O. BOX 2491, AUCKLAND.

Announcing

TWO IMPRESSIVE NEW SUPER QUALITY RECORDERS

for home or professional recording



Celsonic

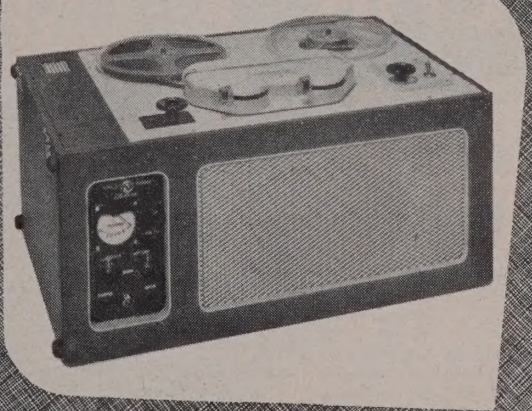
The only Tape Recorder available with Lip-Perfect Film Projector Synchronisation

Absolutely no "wow" or "flutter", extremely low distortion and wide frequency response make this machine ideal for all serious work in high fidelity recording both of music and spoken material. All standard size reels can be used, up to 3,280 ft. Tape speeds (by interchangeable capstans) 3¾, 7½, 15 in./sec.

Full Track and Half Track Models available.

Reflectograph

Specifications normally found only in studio recording apparatus make the Reflectograph the most versatile instrument of its class. Available in various forms to meet individual needs. Not just another tape recorder but a machine to give top class performance where only the best will suffice.



ERL — LEADERS IN THE FIELD OF ELECTRONIC DEVELOPMENT

Electronic Research Ltd.

Inquiries welcomed! For full information write to:

ELECTRONIC RESEARCH LTD.
DEVON STREET,
NEW PLYMOUTH.

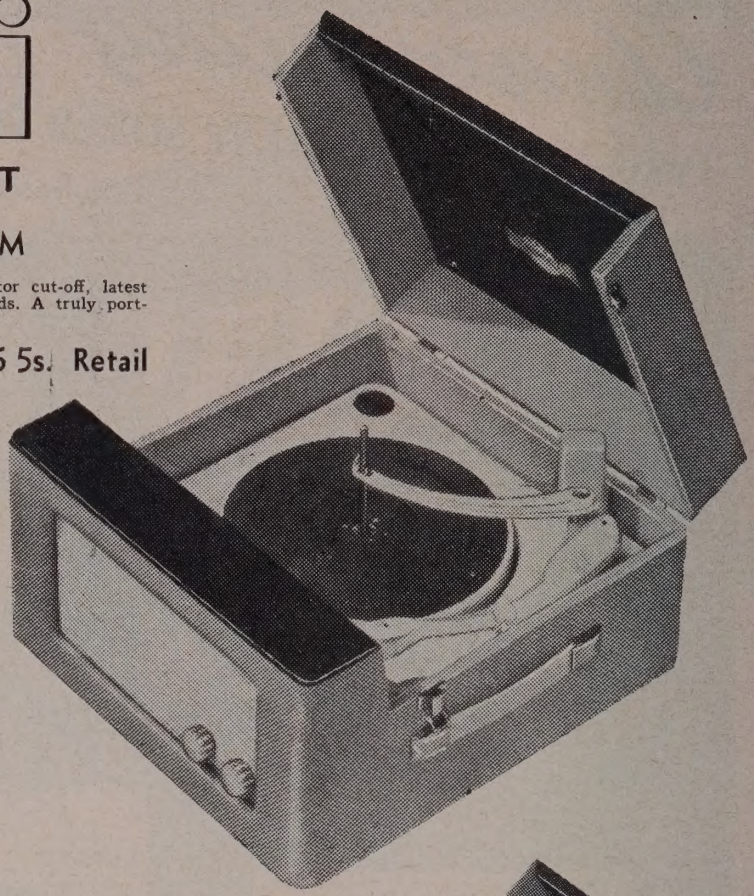
Hi Fi

AT ITS FINEST

E.A.R. AUTO BANTAM

With "Studio" turnover pick-up, automatic motor cut-off, latest Mixer-Changer for 7 in., 10 in., and 12 in. records. A truly portable instrument for the discriminating listener.

£26 5s. Retail



EAR

ELECTRIC AUDIO REPRODUCERS

(Right): E.A.R. BANTAM (Non-Auto Model)

£19 17s. 6d. Retail

(Far right): A750-T. Designed for the critical enthusiast. Incorporates these special features: Bass and treble boost controls, "studio P" pick-up, 10 in. elliptical dual speaker with electrostatic "tweeter", automatic LP-78 filter switching.

£38 15s. Retail

Other models include:

E.A.R. ARMCHAIR CONSOLETTE

£45 15s. Retail

Balanced High Fidelity by EAR

Full information on this profitable line of E.A.R. instruments from the New Zealand Distributors:

RUSSELL IMPORT CO. LTD.

P.O. BOX 102, WELLINGTON; P.O. BOX 9038, AUCKLAND;
P.O. BOX 1871, CHRISTCHURCH.

there's an

Autocrat

designed and priced for your car

New Zealand's Finest Car Radio!

DISTRIBUTED BY AUTOCRAT DISTRIBUTORS LTD., P.O. BOX 2364, AUCKLAND
MANUFACTURED BY AUTOCRAT RADIO LTD.
Branches: P.O. Box 1409, Wellington, and 38 Oxford Terrace, Christchurch

A10

The Car Radio

exclusively fitted and recommended by these 24 British Car Manufacturers:

A.C.	Humber	Riley
Allard	Jaguar	Rolls Royce
Armstrong Siddeley	Jensen	Rover
Austin	Jowett	Singer
Aston Martin	Lagonda	Standard
Bentley	Lea-Francis	Sunbeam Talbot
Healey	M.G.	Triumph
Hillman	Morris	Wolseley

H.M.V. SMITHS Radiomobile

Two outstanding models available: 6-valve and 8-valve, both embodying push-button and manual tuning . . . both suitable for all makes of cars using either 6 or 12-volt batteries.

The ease of installation, the reliability and clarity of reception make the Radiomobile Britain's best car radio. The prices are: 6-valve, £40 10s.; 8-valve, £43 10s. Prices include aerials and all accessories.

H.M.V. "SMITH'S"
RADIOMOBILE CAR AERIALS

Complementing the Radiomobile, or available separately, ensuring best possible reception under all conditions, H.M.V. offer five smart, completely weather-proof models, with optional roof or wing mountings. From 46s. 6d. to 58s. 6d.

Special equipment is available for: Holden, Ford (Consul, Zephyr, Customline), Packard, Vauxhall, Hudson, Chevrolet, Dodge, De Soto, and other leading American & Continental cars.

●

H.M.V. SMITHS RADIOMOBILE

Wholesale Distributors: HIS MASTER'S VOICE (N.Z.) LTD., P.O. BOX 296, WELLINGTON.

Announcing 2 NEW

Editor TAPE RECORDERS

At the recent Radio Show at Earls Court, London, these "Editor" Tape Recorders caused quite a sensation.

Editor SOUND

HIGH FIDELITY

Gives 3 hours of continuous playing. The Automatic Track Reversal makes this important sales feature possible. Three speeds, 3¾ in., 7½ in., and 15 in. per sec. — electronic eye for both recording level and distortion indication — these are only a few of the many attractive features of the SOUND . . . the completely automatic, simple to use tape recorder, handsomely styled in simulated pigskin.

RETAIL PRICE **85 GUINEAS**

Complete with Crystal Desk Microphone and spool of L.P. Tape.

Editor SOUND

"CADET"

Easy to operate with single joystick control. Completely self-contained — wide frequency range — compact and light weight for easy handling — may be used as a separate amplifier. Fitted in simulated pigskin suitcase with Continental fittings.

RETAIL PRICE **53 GUINEAS**

Complete with microphone and spool of tape.

ALSO THE **POPULAR** DE LUXE MODEL

That has been such an outstanding success since it was introduced to the N.Z. market a few months ago.

RETAIL PRICE **78 Guineas**

Complete with microphone and L.P. tape.

WRITE FOR DETAILS TO THE NEW ZEALAND AGENTS:

C. & A. ODLIN TIMBER & HARDWARE CO. LTD.

P.O. BOX 1995, WELLINGTON

ACOUSTICAL QUAD II

For the closest approach to the original sound in speech and musical reproduction.

PRICE £67 complete

(Power Amplifier not illustrated)

★ Push-button selection of recording characteristic compensation.

★ Plug-in units to provide optimum matching conditions for ANY pick-up.

★ Push-button selection of inputs, radio or microphone.

★ Continuously variable filter with selection of 3 starting points.

★ Extremely low distortion. ★ No overshoot on transients.

★ Treble and bass controls. ★ Three input channels.

★ Two power output sockets for tuners, etc.

W. G. LEATHAM LTD. 43 TARANAKI STREET P.O. BOX 1284 WELLINGTON

New midget to challenge all comers!

Reslo Miniature Ribbon Microphone

Latest and most impressive of the tremendously popular Reslo line, miniature ribbon type RB is packed with features to attract every customer in the market for a microphone.

Smallest high quality instrument of its class ever produced, its beautiful styling and finish place it in the front rank in industrial design.

Nothing has been lost by this streamlining and much indeed has been gained. The detachable pre-set ribbon remains, but in greatly improved form with simplified assembly and near automatic accuracy in setting. This self-servicing feature originated with RESLO and is still the only practical example in use. An entirely new magnet system smaller in size but higher in energy produces a very useful increase in output whilst linearity is bettered beyond the already outstanding characteristic.

WRITE TO THE DISTRIBUTOR FOR FULL DETAILS NOW!

New Zealand Distributors:

AMALGAMATED WIRELESS (AUSTRALASIA) LIMITED

P.O. BOX 830 WELLINGTON. P.O. BOX 1363, AUCKLAND,
P.O. BOX 2084, CHRISTCHURCH.

The compact, rugged, multi-range test set you've been waiting for!

THE AVO INDUSTRIAL TEST SET

FOR INDUSTRIAL
AND MARINE USE

Comprising:

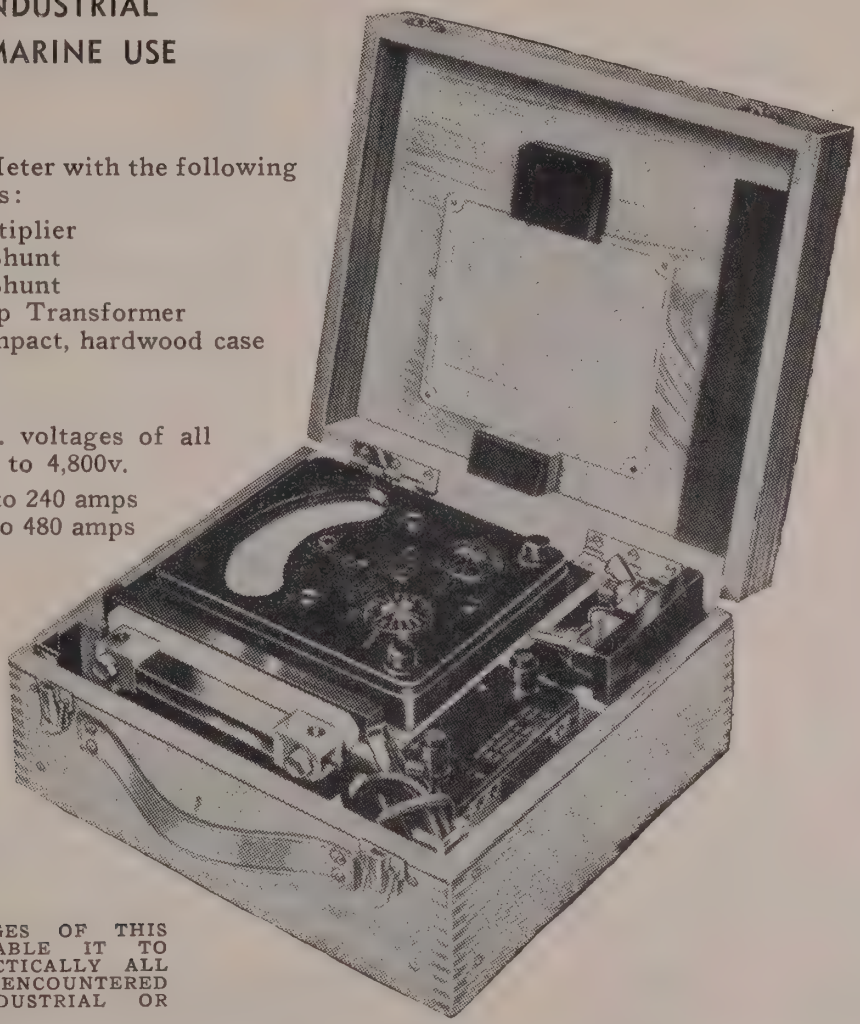
Model 40 AvoMeter with the following Accessories:

1-4800v. Multiplier
1-120 Amp Shunt
1-480 Amp Shunt
1-60/240 Amp Transformer
in tough, compact, hardwood case

Testing Range:

A.C. and D.C. voltages of all values up to 4,800v.

A.C. current up to 240 amps
D.C. current up to 480 amps



THE WIDE RANGES OF THIS INSTRUMENT ENABLE IT TO DEAL WITH PRACTICALLY ALL MEASUREMENTS ENCOUNTERED IN NORMAL INDUSTRIAL OR MARINE USE.

Detailed specifications on request from the New Zealand Distributors:

THE NATIONAL ELECTRICAL & ENGINEERING COMPANY LIMITED

AUCKLAND - WELLINGTON - CHRISTCHURCH - DUNEDIN
HAMILTON - WANGANUI - HASTINGS - INVERCARGILL

Important Announcement from

E. C. GOUGH LTD.

We are proud to announce that the

SOLARTRON ELECTRONIC GROUP LTD.

OF SURREY, ENGLAND

have appointed us as their Sole New Zealand Representative

The range of the SOLARTRON CO.'S products is continually expanding. A few typical uses of the equipment include:

- ★ **Vibrating Analysis**
- ★ **Testing TV and Radio Equipment**
- ★ **Servomechanism Analysis**
- ★ **Power Station Equipment Testing**
- ★ **Test Instruments for Radar Equipment**
- ★ **Medical Research Work**

You may be interested in the use of electronic equipment in your field; if so, call on our nearest Sales Office and we shall arrange for a member of our Staff to visit you.

E. C. GOUGH LTD.

P.O. BOX 873 — CHRISTCHURCH — 'PHONE 62-254
P.O. BOX 682 — AUCKLAND — 'PHONE 40-598

TV AND ITS ESTABLISHMENT

READERS of this journal will recall that we have often written about the establishment of a television service in this country, and that we have always deplored the Government's laissez-faire attitude towards it. We have from time to time taken the Government to task, not for failing actively to institute a service itself, but for refusing to have any real policy about it, of any kind whatever. In this, we reflect the attitude of the New Zealand radio industry, on whose behalf we can claim to speak with reasonable authority. Radio manufacturing forms a not inconsiderable unit of this country's secondary industry, and as such, feels that it deserves better of our legislators than to be constantly fobbed off with weak excuses, when all it asks is that a policy be formulated. At least, if that were done, everyone would know where he stands, even if the Government decided that for good and sufficient reasons it was against television, and had no intention of doing anything about it.

It is strange that little has been heard from official circles about the cost of establishing a service, although various people have made sweeping statements to the press to the effect that television is something we cannot possibly afford. That this is true is very much open to doubt, although it cannot be denied that substantial sums of money are involved. Nor can anyone who is in favour of our having a TV service ignore it. Accordingly, this journal is very pleased to print, elsewhere in this issue, the first reasoned estimate of costs that we have seen, made by the managing director of a firm which is well qualified to do so. The estimate, it will be observed, covers not only the opening and running of one or two stations, but takes into account the scattered nature of our population, and pre-supposes a system of TV broadcasting which would go a long way towards the ideal of complete national coverage. Moreover, it makes no attempt to disguise or minimise the probable costs, for such an unrealistic attitude would serve no purpose at all.

On the other hand, we believe that some items of expenditure listed in Mr Hudig's estimate have been set rather on the high side. The relaying of programmes from one transmitting site to another by co-axial cable, and by U.H.F. radio links is a well-established practice in all countries which already have a service, and its technique is well understood. The latter method is the more modern, and, being extremely flexible, is used for many purposes quite separate and distinct from relaying television signals. That is to say, a network of U.H.F. relay stations is almost invariably used for making available literally hundreds of channels for telephone or telegraphic communication, each channel being equivalent to a pair of wires in an ordinary telephone cable, and all channels being capable of operating simultaneously. Thus, although the cost of both methods is high, modern practice is to install wide-band radio links, and to use their enormous capacity for essential communications other than television. It is over-estimation, therefore, to charge the whole cost of establishing and operating these links against a television service, which would use only a small fraction of their total capacity.

We think, too, that Mr Hudig may be on doubtful ground when he uses the rates charged in Australia to advertisers using the commercial television stations as a yardstick with which to measure the probable cost of providing the necessary programmes. Is it known, for example, whether these rates have been struck in the expectation of a substantial profit during the difficult initial period, or whether they are expected to yield a reasonable profit only after several years' operation? If the former is so, the rates will over-estimate the programme costs, and if the latter, the estimate will most likely be nearer the mark.

However, Mr Hudig's figures are most interesting, and he is to be congratulated on his realistic approach. It is of no use at all to listen to those who say, without proper investigation, that we cannot afford a TV service. No one, the Government included, can say whether or not it would prove too costly without thoroughly investigating the matter, and it seems to us that an investigation is what is needed. It is all very well to say that there is no public demand for television. As we have remarked before, no public demand can exist until the public knows just what such a service can do for it. It is not as though television had been tried in other countries and found wanting in this respect. The existence of millions of viewers in other parts of the world is sufficient indication of how any community will take this new medium of entertainment and education to itself, when given the chance. One might just as well have refused to allow motor-cars to be used here in the early part of the century on the grounds that there was only a minute public demand. True, the cases are not exactly analogous, because in the case of motor-cars, no public expenditure was involved. The point at issue, though is that with the introduction of any startlingly new development, there is no demand of any magnitude until the public can see just what its advantages are. In this, no amount of telling will do any good, but an ounce of practical demonstration is all that is needed. Nor, until a TV service actually starts, can any true demonstration of a modern TV system be given. The Government knows that it is begging the question by crying "no demand", and is at pains not to excite the latent demand that must be there. It is high time that a full-scale investigation was instituted of the possibility of starting a service, and it seems to us that the proper method of attack would be to set up a Royal Commission, which would be charged with making a detailed estimate of establishment and running costs, so that the protagonists of television, as well as its detractors, may have a firm ground from which to argue.

The Government seems quite prepared to spend a great deal of public money on such things as the new New Zealand House building in London, which will be of dubious value to the community as a whole. It is surely not too much to ask it at least to investigate, and prepare a live policy on something from which the public will derive real benefits. No doubt, if radio broadcasting had had to be started by the Government, there would have been similar lack of enthusiasm, on the score that it was an innovation that could well be done without. Yet would anyone now suggest that it is merely a costly luxury? We venture to predict that before a television service has been running here for many years it will have achieved for itself an equal place in the community. Not even the Government is game to say that we will never have it—according to the Minister of Broadcasting it must come. So let us have done with arguments, pro and con, and get on with the job of establishing it.

A HIGH-QUALITY AUDIO AMPLIFIER WITH A DIFFERENCE

The title of this article may be a slight understatement, in that the circuit to be described bears little resemblance to any amplifier yet published in this journal. It uses the so-called single-ended push-pull circuit, which appears to have several advantages for this sort of work.

INTRODUCTION

It is not often these days that it becomes possible to offer builders of amplifiers circuits which have advantages over currently conventonal ones, but the present amplifier comes into this category without a doubt. It has some extremely interesting technical features which, however, have not been used merely for their own sake, but because they seem to offer advantages to the would-be constructor of high-quality amplifiers. We make no claim for originality in the development of the arrangement, or of the circuits themselves, for the original circuit was devised some years ago by two engineers of the General Radio Company, in America. Even the application to audio amplifiers is not new, since the Philips concern in Holland, and latterly in New Zealand, too, has made very cunning use of it in commercial radio sets and radio/gramophone combinations. We do think, though, that this is the first time the single-ended push-pull circuit has been used as the basis of an article for constructors, both amateur and professional, and we are sure that our readers will find it of considerable interest.

THE SINGLE-ENDED PUSH-PULL STAGE

First of all, what is meant by this apparent contradiction in terms? Can a stage be both at the same time, or can't it? Well, it can't, so that the term is obviously not a good one. We did not invent it, though, but we must take responsibility for using it. What it really means is a push-pull stage which does NOT use what is generally known as a push-pull output transformer. In other words, no primary centre-tap. However, the new kind of stage is push-pull, all right, in that two tubes must be used, fed with voltages 180 deg. out of phase. Also, the outputs of the two tubes add together in the primary winding of the output transformer, and any second or other even harmonic outputs from the tubes tend to cancel out in the output transformer. This again is characteristic of conventional push-pull circuits, so that it can be seen that the new arrangement really does qualify for the title of push-pull.

Wherein, then, lies the difference between the two circuits? It is not merely a matter of drawing the circuit differently, although some astonishing things can be done in this way! Let us have a look at a couple of simplified diagrams, given in Fig. 1. At (a), we have the usual push-pull circuit, well known to one and all, and at (b) the 'single-ended' arrangement. The (a) arrangement has the H.T. supply fed to the tubes through the centre-tap of the output transformer. As far as the power supply is concerned, the tubes are in parallel, for each draws its own current, independently of the other, and these currents add, to make the total H.T. current twice that of one tube. For A.C. signals, however, the tubes and the load (which can be regarded for present purposes as the primary of the transformer) are all in series. Because of this, the impedance of the load has to be approximately twice that of a load that is suitable for a single valve. (If the valves are in pure Class A, the push-pull load is exactly twice that required by a single tube.)

Conditions in the circuit (b) are exactly the reverse of this. Obviously, the tubes are in series to the H.T. supply, and the same D.C. plate current flows through both of them. Thus, instead of the H.T. voltage being the same as for one tube, and the current being double, as in the (a) circuit, the voltage in the (b) arrangement must be twice that for a single tube, while the current is the same as for one.

From the signal point of view, however, the tubes are in parallel, so that the impedance of the load needed for two tubes is half that required by a single tube, instead of double as in the conventional push-pull circuit. Both tubes feed their signal to the same end of the load, instead of to opposite ends.

In the "ordinary" push-pull circuit, the H.T. current must be fed to the tubes through the primary of the output transformer. In the new arrangement, they cannot be. In both cases, however, the result

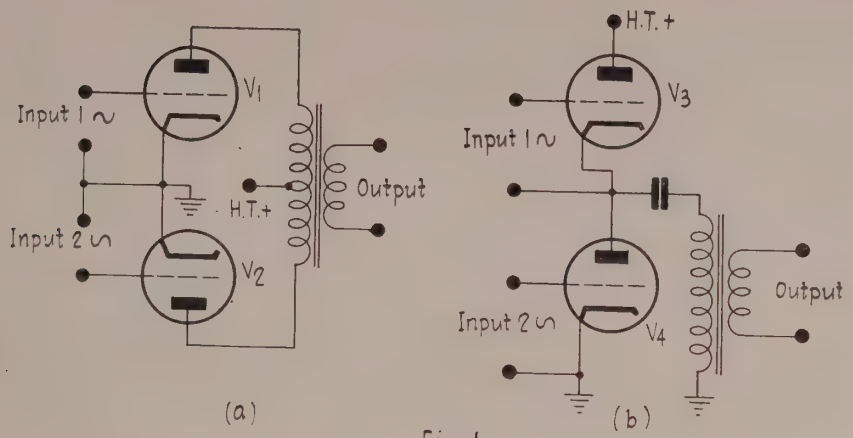


Fig. 1

is the same—namely, that there is no net D.C. in the output transformer primary. In the conventional circuit, this is because the currents of V_1 and V_2 are equal, and are fed through separate halves of the primary in such a way that their magnetizing effects cancel out. In the new circuit, it is because neither tube feeds D.C. through the transformer primary in any case!

UNUSUAL FEATURES

The unusual features of the new circuit have all been mentioned above, either directly or by implication, but a little elaboration would be in order at this stage, to show how the circuit affects other components ofa complete amplifier.

Suppose, for example, that we want to use this arrangement. How will we get on in choosing an output transformer? Also, how do we get the driving voltage for the upper tube? Such questions as these need to be answered before any attempt can be made to build a complete amplifier using this system. To take the output transformer first, it will be obvious from the previous paragraphs that the valves will need a load impedance of a quarter of that used by the same tubes in the ordinary push-pull connection. For example, a pair of tubes requiring a 5000-ohm load in the ordinary way will need a load of 1250 ohms if the new arrangement is used. Fortunately, the same transformer that is available for the tubes in the normal push-pull connection will do the job, if a simple re-arrangement of its primary connections is made. These days, practically all good-quality output transformers have both ends of each half of the primary brought out. For the normal circuit, two of these are connected together so as to put the halves in series, and the joined ends are used as the centre-tap of the whole primary winding. One reason for bringing the ends out and not joining them inside the transformer is that, with the four connections available, it is possible to separately meter the plate currents of the two tubes. Now if, instead of connecting the primary halves in series, we connect them in parallel, we will have a transformer matching the voice-coil impedance to a quarter of the plate-to-plate value for the ordinary circuit. It might be thought that the same effect would be gained by using one-half of the primary, and leaving the other unconnected. As far as turns ratio is concerned, this would be true, but there would be a very grave objection to this course, as it would cause very high leakage

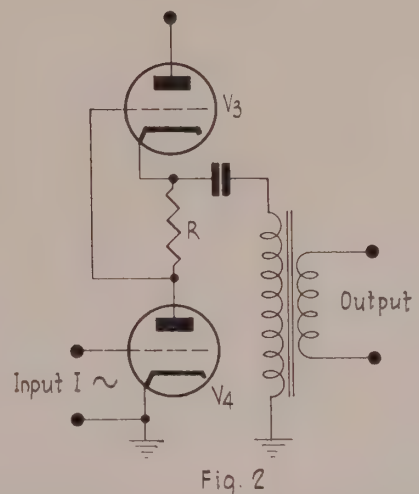


Fig. 2

inductance between primary and secondary, and this could not be tolerated.

Then there is the question of phase-splitting, and of how the upper tube is to be driven. In Fig. 1 (b), it will be noted that the upper tube has to be driven between grid and cathode, with a signal voltage that is equal to that which drives the bottom tube, but which is in opposite phase. It is not just a question of using a phase-splitting circuit and applying one output to each grid, because, if this were done, V_3 would not receive the same driving voltage as V_4. This is because of the cathode follower action of V_3, by means of which the cathode is swinging up and down in the same way as the plate of V_4. There is a simple and quite easy way out of this difficulty, however, illustrated in Fig. 2. A small resistor, R, is inserted between the cathode of V_3 and the plate of V_4. Signal current from V_4 is developed across this resistor, and if the grid of V_3 is returned to the plate of V_4, the polarity of the signal in the grid circuit of V_3 is correct for exciting it out of phase with the grid of V_4. This arrangement allows us to drive only V_4, while the circuit acts as its own phase inverter. In practice, R does not have to be large, and it is usual to make it the D.C. bias resistor of V_3 at the same time. The full circuit of the output stage then becomes that of Fig. 3, in which bias has also been

provided for V_4 by the addition of a further cathode resistor, this time bypassed.

At first, it is difficult to see how both tubes in this arrangement provide power to the load, for the following reason. The same D.C. plate current flows through both tubes, and as these are being operated in Class A, their plate currents must swing in opposite directions at the same time, when signal is being handled. For instance, when the plate current of V_4 is increasing, that of V_3 must simultaneously be decreasing. Obviously, if the average or D.C. plate current remains constant, this must be so, but the difficulty is to see how the plate currents **can** vary at all. since the same D.C. plate current must flow through both tubes.

Now suppose that the grid of V_4 is being driven negative. The plate current of V_4 is thus decreasing, and, owing to the phase-inverting action, that of V_3 is decreasing. The only way in which this can happen is for current to be forced through the load in one direction. Since the current in V_3 is increasing, current will flow in the load from the output terminal to earth, and this current is the useful power output during this half-cycle. On the next signal half-cycle, when the current in V_3 is decreasing, and that in V_4 is increasing, the load current will be in the opposite directioo—namely, from earth to the output terminal.

NEGATIVE FEEDBACK

It should be clear from the above descriptions that with this new kind of output stage, a complete amplifier can be built with very little complication, since no phase inverter is needed ahead of the output tubes. Thus, it is possible to use a single resistance-capacity coupled amplifier stage ahead of the output stage, the three valves making a complete power amplifier with quite adequate sensitivity. If the output stage needs a signal of, say, 10v. peak to fully load it, one-half of a high-mu double triode will give a sensitivity of approximately 150 millivolts for full output, provided that negative feedback is not used. If feedback is applied, it is possible to use a gain-reduction factor of 4, or 12 db., while still retaining a sensitivity of 0.6v. peak for full output. Feedback can be taken, as usual, from the secondary of the output transformer, back to the cathode of the voltage amplifier stage.

POWER SUPPLY

It will be remembered that one of the requirements of the new circuit is for an H.T. supply of twice the voltage used with a single tube. This means, for tubes taking 250 volts on the plates, a supply of at least 500 volts, and supplies correspondingly higher in voltage for tubes requiring higher H.T. supplies. Unfortunately, power transformers suitable for the new circuit are not as yet made commercially, so that, if we are to build such an amplifier, we will need either a special power transformer, or some scheme which will enable an ordinary one to be used.

A possibility is to use two low-voltage supplies in series, both being low-current ones, and so employing quite small transformers. This entails the use of two rectifier tubes as well as two power transformers, but fortunately it is not necessary to use two separate smoothing systems, since the supplies can be connected together in the unsmoothed state, and a single smoothing filter used for the combined supply. This solution is only one of three that could be used. For example, it would be possible to use half-wave rectification, and to connect the high-voltage windings of an ordinary transformer in series, ignoring the centre-tap. This unfortunately causes

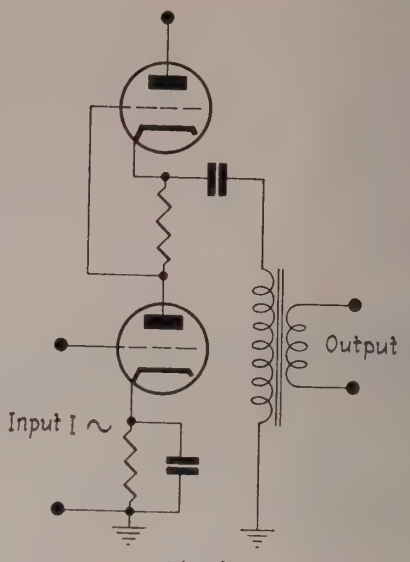
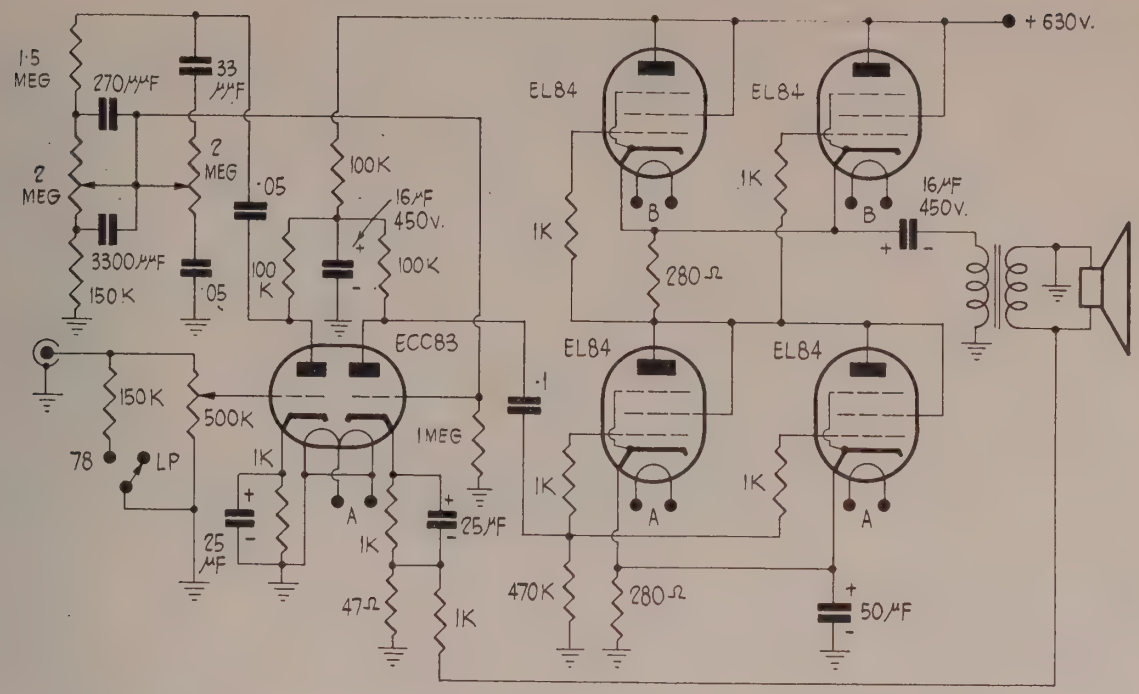


Fig. 3

difficulty in the choice of a suitable rectifier, as the voltage becomes too high for all the usual receiving rectifiers, although the current is well within the rating of most of them. To overcome this would require a transmitting rectifier of quite large dimensions, working at a very much lower current than its maximum rating. This would be expensive and quite uneconomic. Another method would be to use a voltage doubler circuit, but these arrangements, while well suited to applications where the voltage is high and the current only a few milliamperes, is not very satisfactory for currents of 60 ma. and more. All told, then, the use of two separate supplies and a single smoothing filter is the best solution, and it would certainly come out more cheaply than getting a special power transformer made, with the windings for two supplies on it.

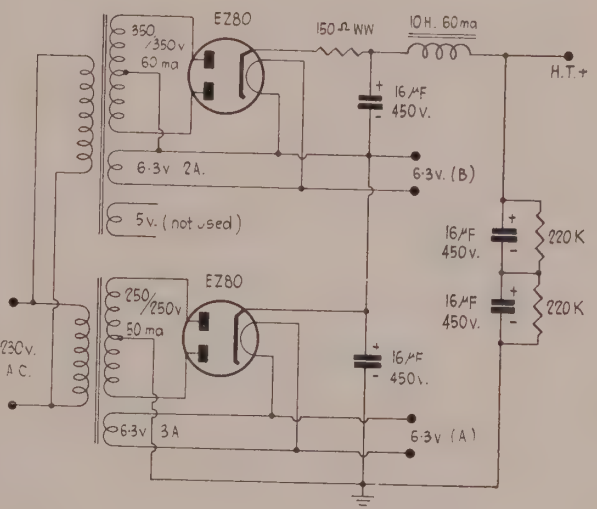
There is yet another difficulty that has not been mentioned. It is the question of feeding the filament of the upper tube in the output stage. The cathode of this stage lives above ground at a potential of more than 300 volts in a typical case. It is thus not possible to feed its heater from a transformer winding that is grounded, because the insulation within the valve between heater and cathode is not rated to stand more than 100 volts as a rule. The only way out of this one is to provide a separate heater winding for the upper push-pull output tube. It could be done by using a separate filament transformer, but this would add still more to the expense of the scheme. However, if for the H.T. supply, two identical small-power transformers are used, each of these will have a 6.3v. heater winding. The one belonging to the power supply transformer that is earthed can be used for the lower output tube, and for any other tubes in the amplifier circuit. The heater winding of the upper power transformer can then be used only for supplying the upper output tube. If then the cathode of the upper tube varies in potential, as it does when the amplifier is working, the only voltage between its cathode and heater will be the audio output voltage at the primary of the output transformer. Because the output load impedance is not very high, the signal voltage will not be very great, and will in general come within the tube's insulating rating, even at full output.



A PRACTICAL ARRANGEMENT

As can be seen from all this, there are several most unusual features about this amplifier and its associated circuits. However, they can all be coped with satisfactorialy with a little ingenuity, so that the new scheme will enable a really simple high-quality amplifier to be built quite easily. To illustrate this point, the amplifier illustrated on the first page of this article was built up using only standard parts, obtainable in any radio dealer's. A high-quality output transformer was used, originally intended to match 5000 ohms to voice-coils of either 16, 9, 4, or 1 ohm, according to the way in which the secondaries are interconnected. For present purposes, the two halves of the primary winding are connected in parallel. There are four primary leads brought out, and it is necessary to connect them in parallel the proper way, otherwise they will oppose each other, and the output will be zero! Two of the leads are blue, and two red. To make the proper connection, it is only necessary to connect the blue end of one winding to the red end of the other. This hardly seems logical, for common sense would suggest that similarly coloured ends of the two windings should be joined. The reason is, of course, that corresponding ends of the two windings are coloured oppositely, not similarly. This is done because of the usual push-pull connection of the transformer, where the two ends to be connected to the valves' plates are similarly coloured, as are the ends that are joined for connecting to H.T.

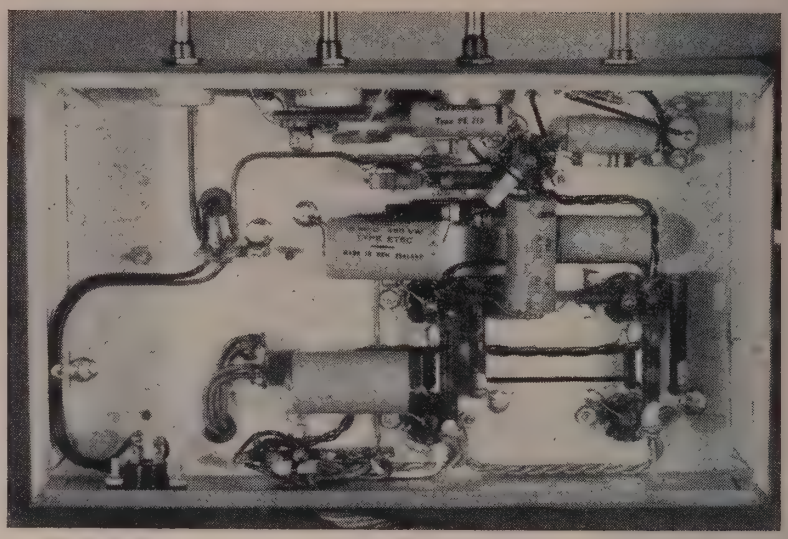
Even armed with this piece of knowledge, it is still possible to inter-connect the windings wrongly unless the leads belonging to both windings have been identified. If this has not been done first, it is



possible to end up with two connections which do nothing more than short-circuit each winding! So, to avoid disappointment, use an ohm-meter, or a pair of headphones and a battery, as a continuity tester. This will tell which leads belong to which winding, so that the proper connections can be made.

The amplifier uses four output valves, in two parallel pairs, in order to make available an output of almost 10 watts. The valve data book advises the use of a 10,000 ohm plate-to-plate load for a pair of triode-connected EL84s. Thus, in the new circuit ar-

rangement, the voice-coil would need to be matched to an impedance of 2500 ohms. This would not suit the stock transformer chosen for the expriment, but by using four EL84s, which in the ordinary push-pull parallel connection would need a load of 5000 ohms, we obtain a requirement for a load of 5000/4, or 1250 ohms. This is exactly the matching we get if we take our transformer, made for 5000 ohms plate-to-plate, and connect its primaries in parallel, as described earlier. In connecting the two pairs of EL84s in parallel, the plates and screens are directly connected, as are the cathodes, but 1000-ohm grid stoppers are connected as close to the grid pins as possible, as an insurance against the high-frequency oscillation that sometimes occurs when high-Gm tubes are connected in parallel. The grids are then paralleled by connecting the outer ends of the grid stoppers together. The cathode bias resistors of 280 ohms are obtained by using two 560-ohm resistors in parallel. Phase inversion is obtained in the output stage itself, as described earlier, by leaving the upper cathode resistor unbypassed.



Under-chassis view of the amplifier.

EARLIER STAGES

The rest of the main amplifier consists of one-half of an ECC83, resistance-capacity coupled to the grid circuit of the lower pair of output tubes. The cathode bias resistor of 1000 ohms is connected to earth through a 47-ohm resistor, which forms the lower leg of a voltage divider applying negative feedback to the cathode of this tube, from the voice-coil winding of the output transformer. Care must be taken to see that the 25 μf. cathode bypass condenser goes across the 1k. resistor, and not from cathode to earth in the usual way.

In order to provide the usual facilities for gramophone reproduction—namely, compensation for the frequency responses of 78 and L/P records, and controllable boost and cut for both treble and bass, the remaining section of the ECC83 is used. The circuit shown is one specially suited to the popular Ronnette P and PX cartridges, and while it is exceedingly simple, it gives excellent results. The 78/L/P switch does no more than alter the load resistance connected across the pick-up terminals, thus relying on the characteristics of the pick-up itself to effect proper compensation, since the frequency response varies according to the resistive loading, and can be made to compensate for the two main types of recording characteristic almost exactly, by a careful choice of the resistance. For L/P, the appropriate value is 500k., so that all this is necessary is to use a 500k. potentiometer as the volume control; for L/P records, this is the only load on the pick-up, while to alter the response suitably for 78 r.p.m. records, a 150k. resistor is switched in parallel with the volume control. If this value cannot be obtained (and it will be difficult these days), it should be made up from two resistors of 100k. and 47k. in series.

The variable tone controls are obtained by a circuit that has often been used in these pages in various modifications. It is also very similar to the one used for the same pupose in the popular Mullard 5/10 amplifier. The network causes a considerable loss of signal, however, and this, together with the fact that the pick-up output is not very great, makes necessary the extra amplification provided by the first half of the ECC83. Note that the two halves of the ECC83 are fed their H.T. supply through a decoupling network consisting of 100k. and 16 μf. This should on no account be omitted, both because of the additional smoothing it gives for these high-gain stages and because it helps to assure freedom from motor-boating.

CONSTRUCTION OF THE AMPLIFIER

It is not always appreciated that there are sometimes advantages in building an amplifier on one chassis, and its power supply on another. In this case, the amplifier itself does not take up much room, but the power supply is rather more bulky than usual, because of its two power transformers. If all were together on the one chassis, quite a large one would be needed, but with them separate, each is quite small. This makes it a simple matter to install the amplifier in the same cabinet as a record player or changer, making a compact installation, which, moreover, removes the heat of the transformers from under the turntable, and makes ventilation easier to secure. The lay-out of the amplifier is straightforward, and can be clearly seen in the photograph. At the left-hand rear corner is the output transformer, and the four output tubes are to its right, disposed at the corners of a square. In front of these is the ECC83. The four controls arranged along the front of the chassis are, from left to right, treble, bass, volume, and 78-L/P switch. The input socket for the pick-up is on the chassis top, conveniently close to the volume control and the switch. Most of the components associated with the tone control network are mounted on the potentiometers themselves, so that few insulated tie-points are required. However, where the junctions of condensers and resistors would be otherwise unsupported, it is advisable to

install these tie-points, in order to prevent the components from shifting and possibly causing short-circuits. In the construction of any electronic equipment, one of the golden rules is never, under any circumstances, to leave small parts unsupported at either end. If this rule is adhered to, short-circuits are unlikely, even if one's wiring skill is not such as to result in a professional-looking job. Also, with tie-points provided for every joint that cannot be made to a valve socket pin, or similar soldering lug. dry joints are very much less likely to occur. It is possible to insert all the wires that must go to a given solder lug through the hole or slot therein, bending the wires round with long-nosed pliers. Then, after all wires are installed, a touch with the soldering iron and a piece of resin-cored solder is enough to make a perfect joint.

POWER SUPPLY CIRCUIT

The principle of the unusual power supply for this amplifier has already been described, so we will not go into it again. There are, however, one or two points that should perhaps be mentioned. First of all, it will be noticed that the transformers are not identical. One is a 250-a-side and the other is a 350-a-side. The reason for this is that a pair of transformers of only 250 v.-a-side would not give quite enough output, while two 350s would give rather too much. As it is, the two used do give slightly too many volts unless something is done about it. The "something" is to be found in the 150-ohm wire-wound resistor between the cathode of the upper rectifier tube and its 16 μf. input condenser. It will be seen that each transformer has its own input condenser, and it is at this point that the separate supplies are connected in series. The filter, comprising the 10 H. choke and 8 μf. of electrolytic condensers, is common to both and deals with their combined hum voltages. The output smoothing condenser must be made from two electrolytic condensers in series, in order to obtain a sufficient voltage rating. An important part of this scheme is the addition of 220k. across each condenser. If this is not done, there is a probability that one condenser will have less leakage than the other. In this event, the better condenser (i.e., the one with the smaller leakage) will have a higher voltage across it than the other, and it is quite possible for this one's voltage rating to be exceeded, thus causing it to break down. As long as the shunt resistors are both much lower in value than the leakage resistances of the condensers, they will share the voltage equally, and each will will run well below its maximum rating.

PERFORMANCE OF THE AMPLIFIER

With the values shown in the diagram, the negative feedback applied to the amplifier amounts to approximately 12 db., which is the same thing as a gain reduction of four times. Maximum output from the tubes was found to be 9.6 watts. At this output, intermodulation distortion was measured with input frequencies of 40 and 4000 c/sec., and found to be 1.8 per cent. A series of measurements at lower power outputs gave the results shown in Table 1, below.

Table 1

IM Distortion, 40 and 4000 c/sec.

0 db. = 9.6 watts (clipping level)

Output	IM Distortion
0 db.	1.8 %
— 3 db.	1.0 %
— 6 db.	0.55%
— 9 db.	0.38%
—12 db.	0.30%

These figures put the amplifier into the best possible class, judged solely on intermodulation distortion.

The frequency response was measured from the input terminal, after first setting the variable controls for flat response. This was done by using a square-wave input at 1000 c/sec., both bass and treble controls being adjusted for the best possible reproduction of the input waveform. To make the adjustment, the bass control is moved until the top of the wave is as flat as possible (i.e., sloping neither one way nor the other), while the treble control is moved until the rise-time of the leading edge is as short as possible, without the introduction of overshoot. This is quite a sensitive method of adjusting the variable controls, and it checks very well with much more time-consuming methods of checking over the whole audio range, after setting the controls so that the response at three points is the same. If a square-wave generator is not available, but an audio oscillator is, the best procedure is to use an input frequency of 1000 c/sec. first, with which to set a convenient output level, well within the capability of the amplifier. The level is observed on a V.T. voltmeter, or an oscilloscope; next, the frequency is changed to 40 c/sec., and the bass control is adjusted until the output level is the same as it was at 1000. Then the frequency is taken up to 4000 c/sec., and the same level is obtained, this time by adjusting the treble control. After this, a check is taken over the whole audio range, and it should be found that the response between 40 and 4000 c/sec. is perfectly flat, indicating that the controls are in the positions in which they have no effect at all on the frequency response.

In testing the original, the response was found to be flat within 1 db. from 20 c/sec. to 30 kc/sec. Above this there was a gradual falling off, with no sign of any undesirable peaks, and at 60 kc/sec. the response was 3 db. down from the level at 1000 c/sec.

The stability margin of the amplifier was at least 8 db. as shown by the fact that 20 db. of feedback could be applied, without any sign of instability either by way of motor-boating or of high-frequency oscillation.

Square-wave tests were undertaken, and it was found that droop at the low-frequency end, and rise-time and overshoot at the high-frequency end were all excellent, although precise measurements were not taken. On listening tests, nothing of an objectionable nature showed up. Reproduction was very crisp, yet with no sign of "edginess," and, as was expected from overload tests with square-waves, the overload performance was excellent. Even when the oscilloscope showed that individual transient peaks were being clipped, there was very little audible effect.

Altogether, the performance of this amplifier was excellent in all respects, and it is capable of doing justice to the best and most expensive associated equipment in the way of loudspeakers and pick-ups. This shows that the new arrangement has something more to recommend it than mere novelty. There are a number of possibilities inherent in the circuit that are not exploited in this application, and it looks very interesting for such applications as modulator for transmitters, not excluding low-powered wide-band television transmitters. However, these will have to be left for future articles.

(Concluded on page 36)

Transistors

JUNCTION TRANSISTORS AS OSCILLATORS

SOME R.F. EXPERIMENTS WITH HEARING-AID TRANSISTORS

INTRODUCTION

Transistors seem to be getting into the news pretty regularly at the present time, what with transistorized portable gramophones in this country, and transistor portable radio receivers in America, not to mention midget transistorized Geiger counters for uranium prospecting, and "electronic B batteries", to mention only a few applications of immediate interest. Accordingly, this journal has felt for some time that some practical articles on the uses of transistors would not go amiss, especially as it has always been our policy to keep as close abreast of current developments as the supply situation allows. Before we start to describe some experiments undertaken recently by our laboratory, it might be as well to say a little about the background of transistors in relation to their use at radio frequencies.

TRANSISTORS AT R.F.

Those who have not had occasion to do anything with transistors so far (and that no doubt includes many of the readers of this article) will probably want to know why it is that transistor portable receivers have been on the market in America for some time, but have not yet made an appearance in this country. The reason is almost entirely one of the non-availability of suitable transistor types in New Zealand. In America, the birthplace of the transistor, many large companies are working on the development of transistors, and a range of types has been made available by firms like R.C.A. and others that are suitable for R.F. applications. So far, it has happened that the European transistor manufacturers have concentrated mainly on transistors for audio applications, presumably on the principle that the largest single application for transistors is the hearing-aid market. It so happens that most of the available transistors here have been from the Continent, with the result that types which are really suitable for R.F. and I.F. use in broadcast receivers are only just becoming available for experimental purposes. When these types are freely available in quantity to radio manufacturers and when the latter have developed suitable receivers incorporating them, we shall certainly see transistor portables on the local market.

Now the reason for this apparently slow rate of development is the nature of transistors themselves. The first ones to be developed were the point-contact types, which were nothing more than a crystal diode with two cat's-whiskers, placed very close together on the surface of the crystal, instead of one. These were made to function at radio frequencies relatively early in the piece, but for some years, development has been away from point-contact transistors, as being too unreliable in their characteristics, and too difficult to make. Most of the difficulties associated with point-contact transistors do not occur with junction transistors, which, as their name implies, do not possess any cat's-whiskers, as such. They are rather of sandwich construction, in which three layers of germanium are in intimate contact with each other. There are two types of germanium, p-type and n-type, these comprising metallic germanium, each with its own particular sort of impurity in very minute quantities. If the kinds of "impurity" are not very carefully controlled, or if their quantity does not come within very closely controlled limits, the material is useless, and a transistor made from it does not work. The three layers of material are not made separately, and then clamped together to form a sandwich. Instead, they are made by a combination of physical and chemical processes that it is not possible to discusss here. The junctions between the three layers of p- and n-germanium are often made by a process of growing a single crystal of metallic germanium first, say from molten p-type metal, then growing on a thin layer of n-type metal, and finishing off with a further layer of p-type. The resulting crystal is then cut into minute slices, each containing the three layers, somewhat like a cake! From this description it is easy to see that physically, the finished transistor contains no parts that can move with respect to each other, and that once it is made, it is solid and indestructible, except of course, by passing too much current through the junctions.

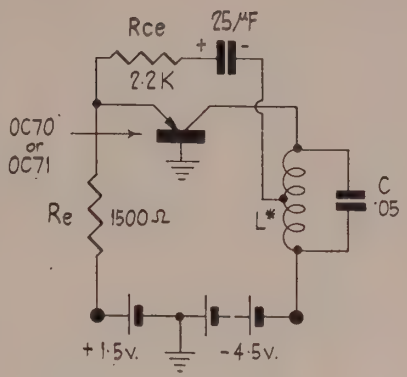
The result of all this, is that junction transistors are unaffected by mechanical shock, and are non-microphonic, as well as being undamaged by dropping or rough treatment. They are thus much more suitable for use in practical equipment than are point-contact transistors, and as we said earlier, they are tending to displace the latter for all applications other than a few very specialized ones in which the peculiar properties of the p.c. transistor enable it to do things that the junction type cannot.

Unfortunately, the very real advantages of junction transistors are accompanied by some disadvantages, perhaps the most difficult to overcome being that their frequency response is severely limited. For example, in the type of circuit most used for audio amplifiers in hearing-aids, ordinary junction transistors' frequency response starts to drop off at approximately 10,000 c/sec. For hearing-aid work this is no disadvantage, but it is a bit awkward if we want to make R.F. amplifiers, working at something like a hundred times the frequency, even when in the broadcast band! However, high-frequency junction transistors are being developed all the time, and new types, working at higher and higher frequencies are becoming available gradually. Already, samples of the Philips OC44 and OC45 have appeared. The former is designed specially as a frequency converter or mixer in the broadcast band, and the latter, as an I.F. amplifier for 455 kc/sec., and thereabouts. At present, though, Philips have not yet put out a type which they recommend as an R.F. amplifier for the broadcast band, but even so, it would be quite possible to build a complete superhet receiver, without R.F. amplifiers using these and the audio amplifier types of Philips transistor.

Also available in small quantities are Telefunken transistors. This maker also has a range of types covering audio and I.F. amplifier types, while our intelligence scouts tell us that there will shortly be samples available of an R.C.A. junction transistor of a new type which should be useful as an R.F. amplifier in the broadcast band, and possibly higher.

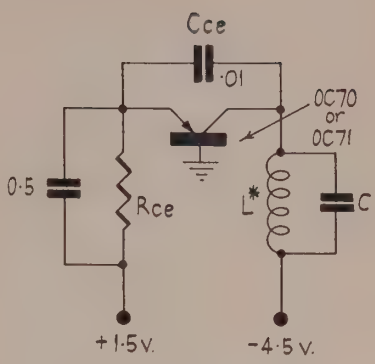
R.F. OSCILLATORS WITH A.F. TRANSISTORS

In view of all this, then, it may seem silly to talk about making R.F. oscillators out of transistors that have been designed as audio amplifiers exclusively, but in practice it is not, because one type, the Telefunken OC624 works consistently as an oscillator up to at least 1400 kc./sec.!



* L is wound on pot core type D 25/16/3B3 270 turns tapped at 20 turns

Fig. 1



* L & C same as Fig. 1

Fig. 2

This is not due to any special technical wizardry on our part, but simply to some slight knowledge of how the things work. In specifying the high-frequency limit of a transistor, manufacturers quote what is known as the α–cut-off frequency. This may be defined as the frequency at which the current amplification falls to 0.707 of its value at some low frequency (usually 1000 c/sec.) when the transistor is used in a grounded-base circuit. Now for various reasons, grounded-base circuits are very seldom used, the most common arrangement being the grounded-emitter circuit. The grounded-base circuit may be roughly compared with the grounded-grid circuit for valves, while the grounded emitter is more like the grounded-cathode valve circuit—in other words, the normal arrangement. It is when the transistor is used in the grounded-emitter circuit that its amplification falls off much earlier than in grounded-base, and the former is the arrangement that is almost universally used for audio amplification. For example, a transistor whose grounded-emitter amplification starts to fall off at 10,000 c/sec. will often have an α–cut-off frequency of 40 times this, or 400 kc/sec. This means, that in a grounded-base type of circuit, the same transistor could possibly give useful amplification at frequencies up to 400 kc/sec.

Now when we talk about oscillators, we are really discussing amplifiers too, because it is impossible to make an oscillator without some form of amplification. Any oscillator can be regarded as an amplifier in which the output, or some of it, is fed back to the input. Now if this loop is broken, and the amplification measured from the input to the output and back to where the feed-back voltage is applied to the input once more, it will be found that in all cases, the measured amplification is more than unity. If it is not, the circuit will not maintain itself in oscillation. But the big point is that provided the gain round the loop is greater than one, the circuit not only can, but must oscillate, provided only that the feedback voltage is in phase with the input voltage. Because of this, it is plain that an oscillator is an easier thing to make work, under difficult conditions, than an amplifier. For an amplifier with a gain of, say, 1.1 or even 2, is seldom of any practical utility, but if we can make the gain round the loop of an oscillator circuit equal to 1.1, we can make a successful oscillator. It follows, therefore, that whether we are talking about valves or transistors, or any other amplifying device, it is possible to make an oscillator function at a higher frequency than the highest at which the device will act as a useful amplifier.

This being so, it ought to be possible to make a transistor with an α-cut-off of 400 kc/sec. work as an oscillator at frequencies considerably higher than this. This is quite true, in practice as well as in theory, and our laboratory has built oscillators using ordinary hearing-aid transistors, working strongly at frequencies as high as 500 kc/sec. for an OC71, and 1400 kc/sec., for an OC624.

The identical circuit arrangements that enable these transistor types, which were designed only for audio frequency applications, to work as R.F. oscillators, will function up to several megacycles per second if transistors like the OC45 are used in them. This is quite logical, because the OC45 is designed to work as an amplifier, in the grounded emitter connection, up to 455 kc/sec. On the same principle as was discussed earlier, therefore, the OC45 should be capable of oscillating at frequencies well above its α-cut-off frequency. This has been found to be the case, for one sample of OC45—the first tried—oscillated up to 12.4 mc/sec. in grounded-base connection.

SOME PRACTICAL CIRCUITS

For audio oscillators, one of the simplest and best circuits is that of Fig. 1. Here, a tuned circuit is directly connected in the collector circuit of the transistor. The base is earthed, and the positive terminal of the collector battery is earthed also, leaving the negative terminal for connection to the collector. So that the transistor can amplify, its emitter must be biased in the forward direction. That is to say, a current must be made to flow in the emitter circuit

from emitter to base. To do this, a separate battery must be used, with the positive terminal connected to the emitter, and the negative connected to base. It will be seen from this that the two batteries, for emitter and collector respectively, are effectively in series, and provided that it is possible to tap the battery at the required point, a single battery only is needed. A resistor, R_e is in series with the emitter supply, and its value determines the emitter current that will be drawn. It also determines indirectly the collector current that the transistor will take, since once the emitter current is decided, the collector current is decided by the characteristics of the transistor concerned. A useful point to remember about junction transistors, as against point-contact types is that their current gain, when in the grounded-base connection is invariably somewhere between 0.9 and 1.0, a typical value being 0.95. This means that if the emitter current is 1.0 m.a., the collector current will be $1.0 \times 0.95 = 0.95$ ma. With other emitter currents, the collector current will be in proportion. so that should the emitter current be set at, say, 2.5 ma., the collector current will be 2.5×0.95, or 2.375 ma. The factor of 0.95, which we have called the current gain in grounded base connection is given the symbol α, just as with valves the voltage amplification factor is always called by another Greek letter, μ. The exact meaning of the term "α-cut-off frequency" should now be clear. It is the frequency at which the current gain in grounded emitter (α) is 0.707 of its value at low frequencies. It is important to remember that refers **only** to the grounded-base method of using the transistor. Also, by the way, the fact that the current gain is less than one does not mean that the transistor's amplification is less than 1, too.

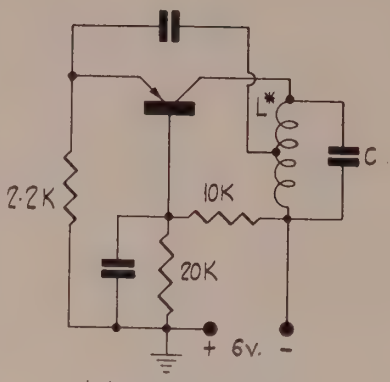


Fig. 3

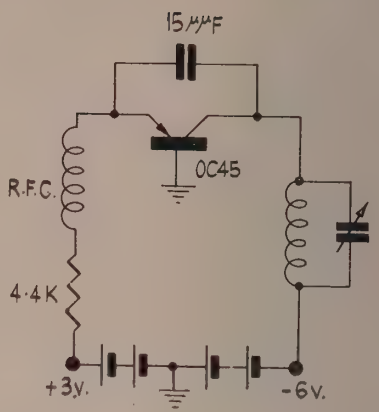


Fig. 4

To get back to our circuit. It will be seen that the value of the resistor in series with the emitter is not high—1500 ohms, in fact, and that the emitter battery is only 1.5 volts. Thus, the maximum current that can flow in the emitter circuit is 1 ma. In actual practice, the current is slightly less than this, because although the emitter-base junction of the transistor has a very low D.C. resistance, it has some, which will make the emitter current a little less than what would flow through 1500 ohms from a battery of 1.5 v. The main purpose of R_e is to protect the transistor from excessive currents. Obviously, since the resistance of the emitter-base junction is so low, very high currents could flow, and ruin the transistor if some sort of current limiter were not incorporated in the circuit. Another reason for R_e is that it enables us to set the transistor current at the most suitable value for the purpose in hand. Most small transistors designed for hearing-aid use perform best at the low currents for which they are designed, and it was found during experimental work that this was certainly true when it came to making them oscillate at as high frequencies as possible. Like valves, transistors' "constants" are not really constant, but vary with the currents that are flowing through the transistor. At high currents, then, α is reduced, and this in turn accounts for the poorer high-frequency performance at large currents.

The circuit is completed by a condenser and another resistor, R_{ee}. This combination provides the feedback which causes the circuit to oscillate. It should be noted here that a grounded-base transistor does not, as a grounded-cathode valve does, produce any inversion of the signal. Thus, when the emitter current is caused to increase, the collector current increases also. In terms of voltage changes at the emitter and collector, an increase in emitter current causes the potential at the emitter to become more positive with respect to earth. The resulting increase in collector current causes the potential at the collector to rise with respect to earth also. This is merely because the collector supply is negative with respect to earth, and is opposite to the usual arrangement with a valve, whereby the potential at the plate falls when the plate current increases. Because of this feature of the circuit positive feedback can very easily be applied from collector to emitter, because no phase inverting device is needed in the feedback connection in order to bring the feedback voltage in phase with the input voltage. The condenser is only for blocking off the D.C. collector voltage from the emitter. Its value is high, however, because the impedance of the emitter circuit is low, and a large value of capacity is needed to ensure that there is adequate response at the frequency of interest, i.e., that to which the collector circuit is tuned. The feedback voltage is taken not from the collector terminal, but from a tap on the tuned circuit. The reason for this is that the impedance of the feedback network is not very high, so that if it were connected to the collector terminal, it would shunt the tuned circuit too heavily, and would prevent the transistor from having much voltage amplification. In fact, if the shunting is too heavy, the voltage amplification might become less than 1, in which case the circuit would not oscillate.

We mentioned earlier that the current amplification is always less than 1 with this circuit, so that it may surprise some to find that the voltage amplification is much greater than 1. This is very simply explained, however. Towards alternating signals, the impedance of the emitter circuit is, as we have already said, very low, but for the collector circuit, exactly

the opposite is true. Indeed, the collector characteristic curves are very similar to look at to those of a pentode valve, which also has a very high A.C. impedance, even though the D.C. resistance, which determines the flow of direct current, is quite low. If we remember these two facts, it is not difficult to see that there can be a very high degree of voltage amplification from emitter to collector, even if the current amplification is less than 1. This being so, it is possible to tap quite a long way down the collector load impedance, and still have a voltage gain greater than 1, and it will be remembered that this is the necessary condition for oscillation to be maintained. In the practical version of Fig. 1, the coil was wound on a Ferroxcube pot core, with a total number of turns of 270. The tap from which the feedback was taken was only 20 turns from the battery end. Thus, the voltage fed back was only 20/270 of the total developed at the collector, and yet this was enough to sustain oscillation quite strongly. This shows that the voltage amplification must have been at least 13.5 times, and in fact it would have been considerably more than that. As for the reduction in shunting on the collector, this is very considerable, for with the tap in the position shown, the feedback chain shunts the collector only to the same extent as a resistor of 4 Megs. connected directly from collector to earth.

With the values shown, the frequency was 1700 c/sec., and the output measured at the collector terminal, was 4 volts peak. With the tuning condenser decreased to 0.004 μf., the frequency was 8000 c/sec., and it was found that oscillation was much stronger, as shown by the fact that the waveform was much more distorted. To improve the waveform, R_{ee} was increased to 20 k., almost ten times the original value, without oscillation stopping. This could be done, not because of any peculiarity of the transistor itself, but because the Q, and therefore the dynamic impedance of the tuned circuit at this frequency was much higher. This corresponds to an increase in load impedance, and, remembering the similarity to a pentode valve, the voltage amplification is directly proportional to the value of load impedance. The higher stage gain thus allowed the value of the feedback resistor to be increased while still maintaining oscillation.

Another, similar circuit, is shown in Fig. 2. Here, the only difference is in the method of applying feedback to the emitter. A capacitative voltage divider direct from the collector replaces the resistive voltage divider formed by R_{ee} and the input impedance at the emitter. It has the advantage that a tap on the coil is not needed, and so can be used with any coil or transformer winding. Once more, the oscillation is stronger at a relatively high frequency, and for the same reason as before. At 8000c/sec., for example, C_{ee} was not needed at all, the internal capacity of the transistor itself providing enough feedback to keep the oscillation going. At the lower frequency, 0.01 μf. was needed. In both cases, the output was the same as in the Fig. 1 arrangement. With both these circuits, greater output voltage could be had simply by increasing the collector battery voltage. No other circuit change would be needed, because the emitter bias current would still see to it that the collector current remained the same. All that would have to be watched would be that the rated maximum collector voltage was not exceeded. This voltage is always quoted on the data sheets for the transistors, and should be looked up, because it varies from type to type.

USING ONLY ONE BATTERY

It is usually desirable in transistor circuits to have only one battery, just as in valve circuits it is no longer common practice to use separate batteries or power supplies for obtaining grid bias. It is possible to do away with a separate emitter bias battery by using a simple combination of R and C, much as in cathode biasing a valve. A circuit which does this is shown in Fig. 3. Here, the emitter resistor is connected to ground, and a biasing network is included in the base circuit. The arrangement is very similar to fixed biasing of a valve by taking the cathode to a tap on a voltage divider, connected between H.T. and earth. To bias the emitter in the forward direction, we need to make the base more negative than the emitter, and this is what the circuit does. It may seem surprising at first to see quite high values of resistance in the bias circuit, but it is not surprising if one remembers that the current in the base circuit is much smaller than that in the emitter or the collector circuits. A clue to this behaviour on the part of junction transistors is given by the fact that the emitter-collector current gain is almost equal to 1. If we take as an example a transistor with an α of 0.95, and assume a collector current of 0.95 ma., emitter current will obviously be 1 ma. The base current, therefore, must be 0.05 ma., because it can only be equal to the difference between the emitter and collector currents. Thus, with the base current small in this way, a relatively large resistor in the base circuit will be needed if any bias is to be developed in it. The base is bypassed to earth in order to prevent loss of signal amplification, so that although the base is not at earth potential for D.C., it is for A.C., and we still have the transistor working in the grounded-base manner. The oscillator circuit is slightly different from the other two illustrated, in that a tap on the coil is used, with a large condenser between collector and emitter supplying the feedback. However, the main point about this circuit is the method of biasing, enabling a single battery to be used. The same bias circuit could be used with any of the other feedback arrangements shown in Figs. 1 and 2, if desired. The values might not be the same for other transistor types, for it should be noted that Fig. 3 is for an OC72. The circuit is taken from a special device which required rather more power output from the oscillator than could be provided by an OC70 or an OC71.

CIRCUIT FOR AN OC45

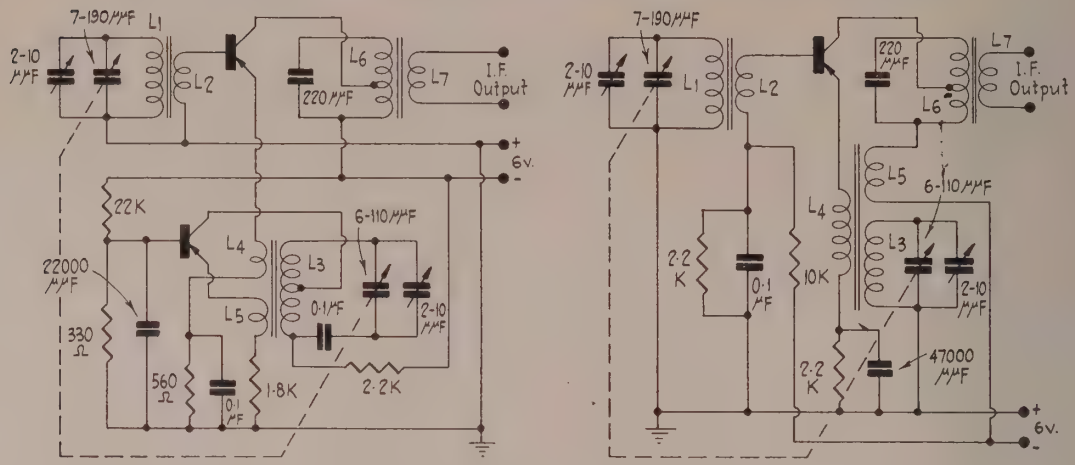
In Fig. 4 we have a circuit for an OC45, which will oscillate up to 12.4 mc/sec. with the one sample used in our experiments. Since the characteristics of transistors are not so accurately maintained as those of most valves, this maximum frequency can be expected to vary widely with different samples of the same type, and we have not yet had time to carry out experiments with a number of samples, plugged into the same circuit. This circuit gave an output of 5.2 v. peak at 8.25 mc/sec., 2.6 v. peak at 11.4 mc/sec., and 0.1 v. peak at 12.4 mc/sec. These figures show that near the drop-out frequency, the oscillation rapidly

(Continued on page 31)

The PHILIPS Experimenter

An advertisement of Philips Electrical Industries of N.Z., Ltd.

No. 109: SOME NEW PHILIPS TRANSISTORS



Two oscillator-mixer circuits using Philips OC44s. L_1 *and* L_2 *are wound on Ferroxcube aerial rods, and the I.F. and Oscillator transformers are wound on Ferroxcube pot cores. Full winding data are given in the* OC44 *data sheet, obtainable on request.*

INTRODUCTION

Those who make a point of keeping abreast of developments in the radio field overseas, cannot have failed to notice that several major manufacturers in the United States of America have for some time had on the market transistorized portable radio receivers. These little sets are true personal portables, to an extent never before achieved. They are small enough to slip into a coat pocket or a handbag, they weigh only a pound or so, they perform very well indeed, and their battery usage is excellent. In short, they have everything that makers have been trying to build into valve-operated portable sets with only limited success, and in addition, they have the inestimable advantage of being inexpensive to operate. They all seem to run from a specially-built 9-volt battery, no larger than a single small torch cell. This enables the size and weight of the set to be reduced far below the practical minimum for receivers using valves, and also accounts for the low battery replacement cost, which in many cases, could be the most attractive feature of the transistor set.

One disadvantage these sets do possess, however; their first cost is high—in the region of $50, and this really is high for the U.S.A., where a five-valve A.C. set can be bought for only $15 or so. The reason, of course, is partly that transistors are still expensive compared with valves, even in the land of their invention, to which must be added the fact that more transistors are needed than valves if a set is to have comparable performance. Six transistors appears to be the minimum, as against four for valves, while many sets use seven.

Here, in New Zealand, no set manufacturers have yet brought out a transistorized radio receiver, although at least two makes of transistorized portable electric gramophone are on the market. This is not only because of the cost of suitable transistors, but also because of their non-availability. It is for this reason that we have much pleasure in announcing the advent of some new types of Philips transistor, specially suited for application at relatively high frequencies.

TYPES OC45 AND OC44

It has always been Philips policy to hasten slowly with the issuing of new transistor types. There is good reason for this, in that many makers and users of transistors have had difficulty through types having been released on the market before they were really developed to a high enough pitch. As a result, new Philips transistors have appeared at relatively infrequent intervals. Also, it has been a matter of deliberate policy to rate existing types conservatively. Readers will no doubt remember that the OC70 and OC71 started life with a collector dissipation rating of 6 milliwatts, which we were later able to up-rate to 25 milliwatts. This is the kind of conservatism that can only work in the best interests of the user, and it has been instrumental in gaining Philips tran-

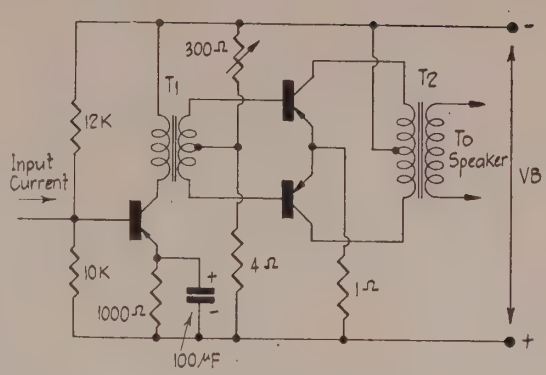
sistors the excellent reputation which they now enjoy. Part of this policy is illustrated in the new OC45, which is recommended as an I.F. amplifier for frequencies up to 455 kc/sec.

Reference to the data sheet on the OC45 reveals that it has an α cut-off frequency of 6 mc/sec., on the average, with a minimum figure of 3 mc/sec. It might be thought, therefore, that to recommend this type for use at intermediate frequencies, and not higher, is being needlessly conservative. One might also consider that it should be suitable for use as an amplifier at least as high as 3 mc/sec., so that it would be useful as an R.F. amplifier for broadcast band receivers. Unfortunately, neither of these suppositions is correct. It must be remembered that the α cut-off frequency of a junction transistor always refers to the grounded-base circuit, which is hardly ever used, and that when the same transistor is connected in the conventional grounded-emitter circuit, the effective cut-off frequency, known as the α^1 cut-off frequency, is very much lower than the α cut-off frequency. Put another way, if satisfactory performance as a 455 kc/sec. amplifier, in grounded-emitter connection must be had from transistors with the normal spread of characteristics, these transistors MUST have an average α cut-off frequency of 6 mc/sec., and a minimum one of 3 mc/sec.

At this point, we would like to emphasize that this does not mean that an OC45 will not work satisfactorily in any application, at a frequency higher than 455 kc/sec. Far from it, for as an oscillator, the OC45 will function at over 12 mc/sec. Nor does it mean that specially selected samples of OC45 would not work as R.F. amplifiers on the broadcast band. What it does mean is that where no special selection can be afforded (since this adds drastically to cost) and where there must be a minimum of manufactured equipments that will not work properly with transistors chosen at random, it is unwise to use this type as a grounded-emitter amplifier at frequencies higher than the normal I.F. range.

We have made quite a point of this, not only because of the OC45, but because a principle is involved which is of considerable importance to all users of transistors. Much the same considerations apply to the newest R.F. transistor in the Philips range, the OC44. This is distinguished from its predecessor, the OC45 by having an even higher α cut-off frequency, which averages 15 mc/sec., with a minimum of 7 mc/sec. This type is recommended for application as a converter, with separate oscillator transistor, or as an oscillator-mixer for broadcast band receivers. Thus, together with the OC45, the OC44 makes it possible to design all-transistor broadcast receivers, provided a stage of R.F. amplification is not required. For example, a set might have an OC44 as an oscillator-mixer, followed by two stages of I.F. amplification, using OC45s, a Philips germanium diode as second detector, and an audio section comprising an OC71 driver, and a matched pair 2-OC72 as an output stage giving 300 milliwatts output.

The conversion gain of an OC44 mixer is typically of the order of 28 db., which compares very favourably with a valve oscillator-mixer, while a two-stage I.F. amplifier using OC45s would have a gain of approximately 60 db. The total of 88 db., compares more than well with similar figures for a set using an oscillator-mixer and single stage of I.F. amplification with valves, especially when these are of the low-drain battery type. As a matter of interest, Figs. 1 and 2 show representative circuits for a mixer stage, with and without separate oscillator using OC44s in both cases. In each case, the aerial is assumed to be a Ferroxcube rod on which the tuned and coupling windings are mounted, while the I.F. transformers and oscillation transformers are wound on Ferroxcube pot cores, type D18/12/3B3. The output windings of the I.F. transformers are arranged to match the input impedance of an OC45 in grounded emitter connection.



Circuit of Class B output stage, using 2-OC16, and driver stage employing an OC72.

TRANSISTOR CAR RADIOS

While the most obvious application for fully transistorized receivers is the battery portable, the possibility should not be overlooked of producing transistor car sets, which would have many advantages.

(1) They would run directly from the car battery, either 12 or 6 volts, so that no form of power converter would be needed.

(2) The drain on the battery would be greatly reduced, making the sets operable from any kind of accumulator, however small.

(3) Through the elimination of the vibrator for providing H.T. power, reliability would be improved, and maintenance would be reduced.

(4) The sets could be made more compact even than at present, so that installation would be simplified, and space in the vehicle would be preserved.

(5) Resistance to shock and vibration would be improved.

(6) There would be other applications opened up for which present-day car sets would not be very suitable, but for which transistor sets may be well suited without modification. Such applications include the fitting with radio of caravans and small boats, in all of which space is at a premium, and the relatively heavy current requirement of valve sets make them less attractive than transistorized ones.

(7) There would be no vibrator hash requiring filtering from battery leads.

Unfortunately, it is felt at the moment that in spite of these advantages, transistors may yet be rather costly to enable them to be fully exploited in the ways suggested. However, they are all the time becoming cheaper, especially for manufacturers' initial

equipment, so that provided that suitable types are available, it is felt that set makers would be well advised to give some practical consideration to transistor car radios.

Of assistance in this direction is the new power transistor OC16. This replaces the earlier experimentally produced OC15, and is very suitable for use as an audio output stage, giving enough output for the purpose. A single OC16 will deliver a power of 1.4 watts, while a pair of them in Class B will give over 3 watts of audio output. For this purpose, OC16s can be supplied in matched pairs, called 2-OC16. The pairs are specially chosen for low distortion in Class B application, and for small differences in standing collector current. Figure 3 shows an output stage of this kind, driven by a single OC72.

A complete car set using this circuit could have the following line-up:

Oscillator-mixer	OC44
I.F. Amplifier	two OC45s.
2nd Detector	OA81
A.F. Amplifier	OC71
Class B Driver	OC72
Class B Output	2-OC16

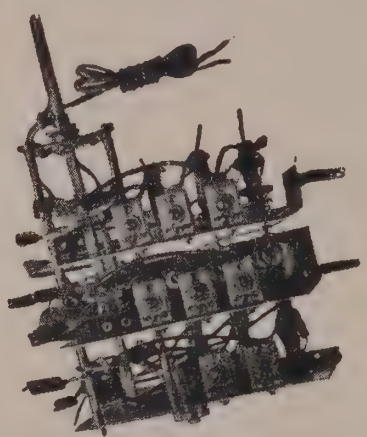
OTHER USES OF THE OC16

The OC16 can also be used in switching operations, such as the working of relays, solenoids, or magnetic clutches, and can be expected to find use in servo-mechanisms. It can be used in relatively high-powered D.C. converters, giving output up to several watts, such as those described in earlier issues of the Philips Experimenter, and in pulse applications of all kinds. The transistor has a peak current rating of 3.3 amps., and can take without damage a collector current of 1.6 amps., averaged over a period of 20 milliseconds.

OTHER NEW TYPES

We have room for brief mention of two other new Philips transistors, the OC73 and the OC76. The former is a p-n-p junction transistor of 50 milliwatts maximum collector dissipation, made specially to have small spread of characteristics, and so to be most suitable for professional applications, where reproducibility of characteristics is important. It can be used as an amplifier, oscillator, or switching transistor for frequencies up to approximately 500 kc/sec., and has an α cut-off frequency of 500 kc/sec.

The OC76 has been designed especially for switching and pulse-oscillating applications, such as D.C. converters, and has a collector dissipation of 50 mw., and a peak collector current as high as 125 ma. A feature of its characteristics is its ability to retain its current amplification even at high currents, so that its transient losses are low.



Poly-Q

B-A-N-D
S-P-R-E-A-D

BASIC KIT — TYPE 9

Completely assembled, wired, and tested up to converter tube. Fitted to sturdy 8/9 valve, plated steel chassis. Accurately aligned to dial calibation. You merely add I.F. and audio stages. The spread on shortwave makes shortwave tuning easier than broadcast.

IDEAL as base for really high-quality
RADIOS, TUNERS, RADIOGRAMS, etc.

Details:
49, 31, 25, and 19-metre bands, plus broadcast. Extremely accurate calibration and frequency stability. Split stator tuning condenser and temperature compensated oscillator. Only three simple adjustments necessary to completely align each bandspread. Handsome floodlit dial scale. Effortless tuning from high ratio 24/1, ball-bearing spin wheel drive. Gang isolated from mechanical and electrical vibration and noise. Bandspread calibration linear and marked in 100 k/c divisions and fractions thereof. A 0–100 logging scale also provided. "BAND", "TONE" and "GRAM." indicators fitted. Special A.V.C. system provides shorter time constant on shortwave to rapidly compensate for fading signal. Polystyrene low-loss adjustable slug coils throughout. Full instructions and suggested I.F. and audio circuits.

Price:
£16/19/7 (retail), less valves, plus packing, and postage.
(Valves, £1/5/6; packing, 6/6; postage, 6/6, approx.)
See them at our Stockists, or write direct for full particulars.

INDUCTANCE SPECIALISTS LTD.
157 THORNDON QUAY : WELLINGTON

NOTE: Special assembly type B10 available covering amateur bands 15/13, 20, 40, 80, 160 metre bands plus broadcast also available.

CATALOGUE: New list of preferred types available on request; specially prepared folder including list and technical data sheets 2s. 6d.

INTERPRETATION OF VACUUM TUBE RATINGS

Many users of valves do not realize just what is meant by the ratings placed upon them by their manufacturers. This short but very clear exposition explains the system in use by American valve makers, and we are indebted to Sylvania Electric Products Inc., U.S.A. for the information printed below.—(ED.)

In order to establish a more complete understanding among users of vacuum tubes of the exact meaning of various tube ratings and to encourage uniform commercial practice in design, this newsletter sets forth the generally accepted interpretations of tube ratings as established by the Radio Manufacturers' Association. All Sylvania rating sheets will be based on these interpretations.

Maximum ratings of receiving tubes are based on either the absolute or the design centre system. Briefly, the absolute system ratings give conditions which cannot be exceeded under any circumstances without probable serious damage to the tube or serious loss in performance, while the design centre ratings—which are almost universally used—give ratings at "normal" conditions for average tubes. (An average tube is taken as one whose characteristics are exactly equal to published ratings.)

The design centre ratings are chosen so that an average tube operating under rated conditions will have a factor of safety allowing for normally-encountered line or battery voltage fluctuations. Thus, a design centre maximum plate dissipation rating allows for an increase to an absolute maximum existing when the primary supply voltage is the highest value to be expected normally. It is true that a tube below average for plate current might withstand continuous use at supply voltages above the highest normally encountered, while one near the top limit for plate current may not give the expected life when operated continually at such conditions. For A.C. and A.C./D.C. operation the design centre supply voltage is taken as 117 volts and is generally assumed to vary ten per cent on either side of this figure. Note that the above factor of safety also applies to drops below normal in supply voltage where emission decrease is a primary limitation.

For battery operation the design centre "B" voltage is taken as the voltage rating of the "B" battery block, such as 45 volts, 90 volts, etc. Absolute maximum power dissipations must not exceed a value 10% higher than design centre maximums. The "A" battery design centre is based on a maximum voltage equal to the fully charged or new battery condition of the kind of battery usually employed for the tube type under consideration, and on a minimum voltage below which the tube will not operate effectively.

For example, the filament rating of the T-3 (subminiature) battery type is 1.25 volts. The "new battery" or absolute maximum voltage should not exceed 1.5 volts, and all tubes cannot be expected to operate properly below 1.0 volts. However, for A.C. operation the drop across any 1.25 volt filament section should not exceed 1.2 volts at 117 volts line. For the 1.4 volt tubes, the absolute maximum for battery operation is 1.6 volts. For A.C. operation the drop across any 1.4 volt filament section should not exceed 1.3 volts at 117 volts line. Note that the A.C. filament ratings of the battery types are somewhat lower than the battery ratings to allow for transient fluctuations in the A.C. filament supply.

Transistor Oscillators

(Continued from page 27)

becomes weaker, and that the limiting frequency for oscillation is higher than the top frequency for useful output.

APPLICATION OF THESE CIRCUITS

Oscillator circuits are useful for a variety of purposes, whatever their frequency, and these transistor arangements can find a very useful place for themselves, especially where extreme portability and low operating power are important. For example, these circuits can be built up so compactly that they could easily be used for building fixed or variable-frequency oscillators into existing equipment, where space is at a premium. For example, audio oscillators are essential for testing and setting up single-sideband transmitters, and it is much more convenient to have them built into the gear, rather than as separate items of test equipment. Two of these circuits could be built into a spare corner occupying only a few cubic inches, so that a two-tone test signal is immediately available. Their current drain is so slight that if a suitable source of negative potential is not available, the inclusion of a small dry battery would not be a nuisance, for its life would be the shelf life of the cells themselves.

Even with currently available transistors, it would be possible to build an all-wave receiver of the superheterodyne type using only germanium diodes and transistors, as long as R.F. amplifier stages could be dispensed with. Pocket signal generators could be built for aligning receivers away from the workbench and its permanent instruments. No doubt many other applications will suggest themselves to readers whose work involves the use of oscillators.

CHANGE OF ADDRESS

When you change your address, be sure to notify the Subscription Department, "Radio and Electrical Review," P.O. Box 6361, Wellington, New Zealand, and do this at least four weeks in advance. To avoid disappointment through not receiving your copy of "Radio and Electrical Review," should it go to the wrong address through your failure to notify us of a change, we earnestly ask for your co operation in this important matter.

CALVERTS have the cabinet you need

STEEL CABINETS

These cabinets have round or square corners as required, and a hinged, recessed door on top. Adequate ventilation is assured by louvres on the sides and a two-inch opening extending the entire width of the back. Stocked in Grey Hammerlux or can be finished in black or grey wrinkle enamel if required. Prices listed do not include chassis or panel.

Panel Space Width x Height	For Chassis	Price
10 x 7	9 x 7 x 2	£2 10 0
13 x 8	12 x 8 x 2½	£2 15 0
16 x 9	15 x 9 x 3	£4 2 6
19 x 10	18 x 11 x 3	£5 0 0
19 x 20	18 x 11 x 3	£13 10 0
19 x 30	18 x 11 x 3	£17 10 0

CABINET PANELS

Panels are blank. Made of 18g. steel and finished in grey or black wrinkle enamel or grey Hammerlux.

10 x 7 7/- 13 x 8 8/- 16 x 9 10/- 10 x 10 15/6

STEEL CHASSIS

Unpunched chassis. Made of 20g. steel and available in either grey or black wrinkle enamel finish or grey Hammerlux.

9 x 7 x 2 12/- 12 x 8 x 2 13/6 15 x 9 x 3 15/- 8 x 11 x 3 20/-

METAL UTILITY CABINETS

These cabinets have two removable sides and are available in either grey or black wrinkle enamel finish or grey Hammerlux.

Depth	Width	Height	Price
3	4	5	9/6
4	5	6	11/–
5	6	9	16/6
6	7	12	22/–
7	9	15	25/–

MINIBOXES

Made of steel and finished in either grey or black wrinkle or grey Hammerlux as required.

Length	Height	Depth	Price
4	2	2¾	7/–
5	4	3	9/6
7	5	3	12/6
12	7	4	14/–

Punching can be done at a small extra cost. Postage and freight paid on orders over £2.

CALVERTS LIMITED

138 TUAM STREET, CHRISTCHURCH

WORLD NEWS OF TV

NORWAY

Of interest to New Zealand is Norway's approach to the problem of starting a television service. A twelve-year plan for a network of transmitters which would reach some 80% of Torway's population by 1970 has been made public. The scheme, which has been drawn up by a Government committee, and which is subject to the approval of the Storting (the Norwegian parliament) would cost approximately £3.1 million. The committee estimates that by 1970, when the network would be complete, about 195,000 Norwegian homes would have television sets installed.

The plan proposes that development should proceed in four three-year stages. During the first stage, television facilities would be provided for the central part of eastern Norway, priority being given to the Oslo area. But even if the Storting approves the plan before the end of 1958, as expected, no regular TV service could be in operation in the Oslo area until 1960 at the earliest.

The committee has proposed that TV licences should cost the equivalent of £4 10s. The plan envisages that transmission time would be eight hours a week for the first year or so, and would later be extended to 16 hours a week. It is estimated that within 10 years of transmissions beginning, the income from licences would more than cover running expenses.

FINLAND

Another small country in which the starting of TV must pose similar establishment problems to those expected in New Zealand, is Finland. The Finnish State Radio has worked out a plan under which the equivalent of £2 million will be spent on television during a period of five years. The main items of the five-year plan are as follows:—

1. It was hoped that an experimental TV service should start in the autumn of 1956, by which time a studio, a transmitter and the necessary equipment were to have been installed in Helsinki. The experimental transmitter (vision 2 kw., and sound 1 kw.) is erected atop the tower of the Olympic Stadium in Helsinki.
2. In addition to the one at Helsinki, transmitters have been planned for Abo, Tamerfors, and Lahti. At Forssa, a relay station is to be built.
3. During the experimental period, the number of programme hours will be about six per week, and before 1960 will be increased to 15, two hours a day on week days, and three on Sundays.
4. Provision has been made on a modern TV building at a cost of about £320,000 for the building itself, and £340,000 for the technical equipment.
5. As long as the experimental period is not delayed, a TV licence fee of £7 15s. a year will be paid, commencing in 1957.

For the programme distribution system, the microwave relay principle will be used. The cost of the relay stations are estimated at £5 million. In the plan, a sum of £230 an hour is mentioned as the programme production cost, inclusive of film programmes. The area to be covered during the first five years has a population of 1,590,000 people—more than a third of the total population.

No plans have yet been made for further extension of the TV coverage. It is expected, however, that after implementation of the five-year plan, transmitters will also be built at twelve other sites, and this is expected to cover about 80% of the population.

SPECIAL TV BROADCASTING FOR NEW YORK HOTELS

In September last, an entirely new television programme service was instituted in New York hotels by the "Hotel TV Broadcasting Corporation". The two large hotels which are to have the new service each have 1000 bedrooms, a large number of which have television receivers on which normal broadcast TV programmes can be picked up. Large TV installations like this invariably use a common aerial, together with distribution amplifiers, feeding the signals to all receivers. It can be seen, therefore, that there is no problem at all in feeding special programmes into this system without radiating it for all to receive.

The Hotel TV Broadcasting Corporation plans to televise special films through the hotel TV systems, the material being specially chosen to give visual information about the city and its attractions to visitors. Suitable films have already been produced for the purpose, and the originators of the scheme expect to have extended their activities to 25 other cities in the U.S.A., with a total of 50,000 hotel rooms included in the networks.

BACK NUMBERS OF "R. & E. R."

Back numbers are available from:

S.O.S. Radio Ltd., 283, Queen Street, Auckland.

S.O.S. Radio Ltd., 1 Ward Street, Hamilton.

Webb's Radios Ltd., 11 Wellesley St. E., Auckland.

Tricity House Ltd., 209 Manchester St., Christchurch.

Ken's Ltd., 142-144 Stuart Street, Dunedin.

Fear's Radio and Cycle Co. Ltd., 31 Willis Street, Wellington.

The Radio Service Co., 83 Guyton Street, Wanganui.

Technical Book and Magazine Co., 295-299 Swanson Street, Melbourne, Australia.

THE IMPORTANCE OF IONOSPHERIC SCATTER

As long ago as 1927, T. L. Eckersley of Marconi's was carrying out intensive research into the ionospheric scattering of short wave radio transmissions. His pioneer work in this field laid the foundations of today's teachniques.

If "Forward Scatter", as it is popularly known, lives up to its present promise—and there seems to be little doubt of this—it may constitute the greatest advance in radio communications since 1924, when it will be recalled, the Marconi-Franklin Beam system revolutionized the teachniques of that day.

The importance of the ionospheric scatter system lies in this:—

Long-distance radio communication, which is normally carried out in the H.F. (High Frequency) band has always had to face one serious obstacle, namely, that it is impossible to transmit on one frequency for twenty-four hours a day, because, at certain times, the signals will fade and nothing can be received at the other end for some hours. Fortunately, different frequencies are effective for different times of the day over a given path, so that when transmission on one frequency is due to fade —and the time it will do so is reasonably predictable—the established procedure is to maintain communication whenever practicable by switching to a different frequency.

This complication is obviously one to be avoided if at all possible, particularly as sudden fluctuations in sunspot activity may affect communication on all frequencies in the band. Even in the absence of such fluctuations, round-the-clock communication is not always possible.

The ionospheric scatter system of propagation, which uses the V.H.F. (Very High Frequency) band, promises to overcome these difficulties. V.H.F. transmissions have, of course, been extensively used for many years, but the effective range has always been regarded as in the region of 30 miles. Now, however, it has been found that, by making use of the ionosphere (and particularly one ionized layer 50 to 70 miles above the earth), distances of 1000 miles or even more can be spanned.

In its simplest form the new system operates in the following manner:—

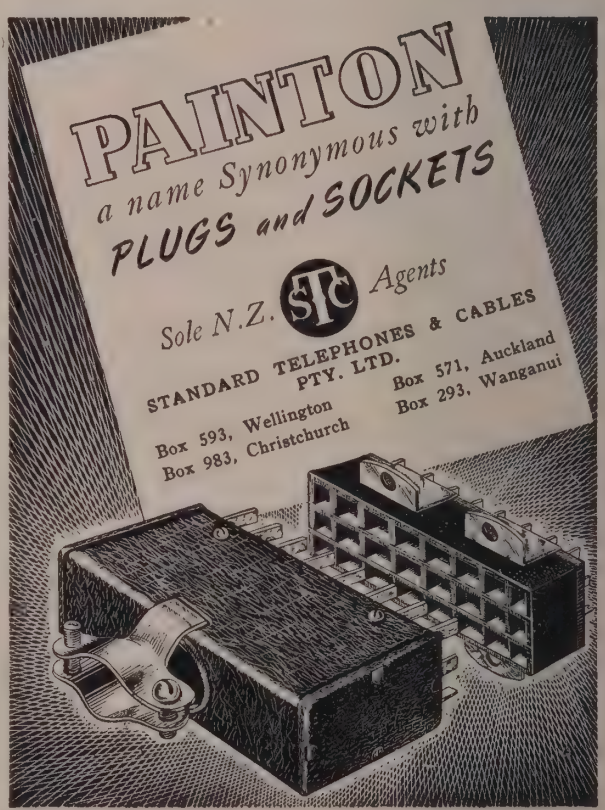
The V.H.F. transmission, instead of being beamed in a path roughly parallel to the earth's surface (as for normal point-to-point working) is directed skyward at a critical angle, until, at a height of 50 to 70 miles, it meets the ionized layer. Much of the radio energy is lost, but an appreciable fraction is deflected forward and downward to return to the earth at a point which may be about 1000 miles from the transmitter. Here it can be received, amplified and re-transmitted by a similar process for another "hop"—and so on until the ultimate destination is reached.

A rough analogy is provided by a searchlight, which, if its beam is directed parallel to the ground is only visible for a short distance, particularly if the country is hilly. If, however, it is directed skywards and strikes a cloud-base, the beam will be scattered but the glow will be visible for a great many miles.

To sum up, therefore, the ionospheric scatter system provides a method of radio communication which can be effected with a high degree of reliability at any hour of the day or night, all the year round. It is virtually unaffected by magnetic disturbances and is therefore eminently suitable for use across Polar regions where magnetic storms are of frequent occurrence.

In the light of present knowledge, ionospheric scatter propogation can be used for the transmission of telegraphy, teleprinter signals or low-quality telephony. It is not suitable for the transmission of television signals, which, being extremely complex, require a bandwidth of at least 3 megacycles. In this connection, tropospheric scatter (a system using much higher frequencies but of shorter range) offers possibilities, but much experimental work has yet to be done before the position can be assessed with certainty.

When there's a better switch
ARCOLECTRIC will make it
New Zealand Agents
GREEN & COOPER LTD. WELLINGTON.



RECORD TALK

by JOHN GRAY

Mercury is the latest overseas label to be recognized on the New Zealand market. Distribution has been taken over by the record division of Pye Limited, and a lengthy first list has appeared. Some records were available under the previous auspices, others are new to us. A very large release of children's records on single 78 rpm is sure of a welcome; the items range from Mother Goose nursery rhymes to traditional fairy tales and the stories of such well-known musical compositions as "The Sorcerer's Apprentice". In addition, there is an extended play 45 of nursery rhymes (EP-C-101). Of standard pop numbers, the headliners as I write these notes are Patti Page's "Allegheny Moon" on 45060, and incidentally you should get quite a kick out of a good old-fashioned waltz tune, "The Strangest Romance", which appears on the reverse of this; and two discs certain to sell by the thousand are those by the Platters. "The Magic Touch" and "Winner Take All" are on 45052, the even more successful "My Prayer" and "Heaven on Earth" are on 45075.

Long playing issues on Mercury afford a great deal of light entertainment. There is, for instance, Patti Page deserting current pop numbers to sing a group of folk song favourites which she does very nicely on MG25101, there is some excellent dance music from Ralph Marterie on MG25121, and Jerry Murad certainly puts his Harmonicats through their paces on 25129. For screen fans, a great deal of the "Miss Sadie Thompson" film may be had on MG25181, and Richard Hayman's Orchestra plays a collection of film themes on MG25189. There is much more in the same vein from this ten-inch release; the twelve-inch popular records range from Emarcy jazz issues to a documentary curiosity in the form of the celebrated Monte Carlo wedding. Besides extracts from the actual ceremony the disc includes a performance, recorded on the spot, of the ballet music written by Stan Kenton for "Homage to the Princess", as given at the Monte Carlo Opera House on the wedding night (MG20149). Finally, the classical release offers impressive samples of Mercury's much vaunted "living presence" technique as employed on several front ranking American symphony orchestras. These records have enormous dynamic range and one can well imagine their being in demand for demonstration purposes. A high-powered version of the Berlioz Symphonic Fantastique is done by the Minneapolis Symphony Orchestra under Antal Dorati on MG50034, and another issue by this famous combination might well be recommended to musical children. On one side of MG50055 is Tchaikovsky's "Nutcracker Suite", on the other, Benjamin Britten's instructive and entertaining "Young Person's Guide to the Orchestra", and both are adorned by an explanatory narrative by Deems Taylor which should render the disc useful in educational circles. For connoisseurs there is one record that should not be overlooked. Doarti and his Minneapolis players are once again featured, and the main attraction is one of Bartok's most fascinating scores, "The Miraculous Mandarin", taken from a ballet which has a story as hair-raising as the music (MG50038). In comparison, the piece on the reverse, Kodaly's variations on a Hungarian folk song "The Peacock", seems almost like a piece of Mozart. This is in every way a stunning disc.

Festival and Coral continue in abundance. The Ink Spots have turned up again, complete with those soulful monologues they love inserting into their numbers: if you like them you will like their versions of "My Prayer" and "Bewildered" on FS1135. The Four Aces are of course more in the limelight these days, and they have sure-fire material in "To Love Again" which by the way is featured in "The Eddie Duchin Story", and which I see is based on the music of a certain Chopin nocturne. Personally I can no longer work up indignation over this sort of thing which is, after all, an unconscious tribute to the worth of the original melody itself. The reverse item is "Charlie was a Boxer" and the number is SP45-1050. Lawrence Welk delivers a little religious philosophy in "Practice, Practice, What You Preach" (though this should perhaps be spelt "Practise Practise") coupled on CS1095 with "What a Heavenly Night for Love". And on ten-inch LP Ethel Merman is back with "Call Me Madam" (FR10-1173). This is from the film version and embraces also the talents of George Sanders and Donald O'Connor. Readers of these pages will be well aware of what I think of Miss Merman. What must she be like in the flesh if she can put so much sheer personality across on a recording?

RCA records are now available in profusion, the majority of them on 45 and all drawing from a very rich selection of popular artists. There is everything from Rock and Roll to Oreste. The latter name belongs to a new tenor who stars in the "Vagabond King" film and bids fair to rival Lanza. Unlike the latter, Oreste has gone to Hollywood after a career of some years in real opera, for this Maltese born singer was, under his full name, Oreste Kirkop, a very well liked singer at Sadlers Wells and elsewhere. On RCA 10139 he sings an appealing ballad "This Same Heart", and a new song, "Lord I'm Glad I know Thee", which, although also featured in the film, is not by Rudolf Friml. Oreste has a first-class voice and style and the record could become a favourite. Six months ago I expressed the hope that the Rock and Roll craze was dying; time has shown that it was only beginning so I must hold my peace, apart from mentioning that RCA's batch now offers Martha Carson in "Music Drives Me Crazy" and "Dixieland Roll" (10188); a plethora of Presley ("Blue Suede Shoes" and "Tutti Frutti" on 20-6636 seems as good a choice of any of them) and the craze has even been taken up by the fruity voice of Vaughn Monroe, with "Rock and Roll Express" on 10158, and has gone west with Eddie Arnold, in "The Rockin' Mockin' Bird" on 10165. On the other hand, plain unexciting melody prevails from such placid combinations as The Three Suns, who offer "Petite Papillon" and "Beautiful Girls of Vienna" on 10160, and Hugo Winterhalter's "Canadian Sunset" shares 20-6537 with "This is Real".

Another new line, Verve Records, has been acquired by Philip Warren, who is at pains to point out that the material is not "re-hashed old stuff". Many of the artists are so well known that perhaps this assurance is desirable. It is a very up-to-date person who can say with certainty which performers are recording for which labels at the present moment! However, it appears that none of the Verves was even recorded prior to April, 1956, and the discs themselves have a decided new look, though one could wish for the titles to be placed nearer the centre of the very spacious labels. The records are all 45s, by the way. You have only to listen to Ella Fitzgerald singing "It's Only a Man" on V5001 to realize why she is regarded simply as "great". This is an excellent ballad superbly put across, and the reverse, "Too Young for the Blues" is not far behind in appeal. A new Spike Jones disc (V5003) gives the mixture very much as we expect, but the "Memories Are Made of This" side is spiked with a "singing dogs" gimmick which would make a cat laugh, and on the back is something called "Sixteen Tacos" together with "The Trouble with Pasquale". For Rock and Roll fans there are Don, Dick and Jimmy, whose offerings on V5010 are "I Never Knew" and "You Gotta Have Eyes". The Clef and Esquire LPs contain as usual a wealth of jazz material. There is a ten-inch disc of Django Reinhardt recorded only a month before his untimely death (MGC516) and many will want MGC156 with its "Soft Moods with Teddy Wilson". From Esquire there are Jay Jay Johnson and Kai Winding in an amazing demonstration of what two trombones can do (20-045) and the Miles Davis Quintet record on 20-041 is a must for lovers of modern jazz.

W and G 45s are also finding a corner in the market. Once again the technical quality is high and there is an interesting proportion of new names. A newcomer to the Country and Western field is Smokey Mac, whose titles on SPN223 are "Be Faithful" and "Second Chance", and the Rover Boys on SPN221 are out to please popular taste with "Sixteen Teens" and "My Queen". The Gayles, another vocal group well aware of today's trends, make their debut on SPN278 with "Shortnin' Bread Rock". Then, for the children we have Paul Dewitt in "The Davy Crockett March" and "Old Betsy"; this is on a seven-inch unbreakable 78, WG XKP238, which will commend it to mothers and fathers, and also on the same handy material is "Blazer, the Fire Engine who was Afraid", engagingly presented by Tody Dean and Toni Waiman (236). The same pair are on hand to tell us about "Tuggley, the Train who could not Swim", on 235.

HMV offer Mario Lanza in two songs from his new film "Serenade" on DA30505, the titles are "Serenade" and "My Destiny". Those who wish for more will of course make for the complete sound track recording which is on ALP1365. Another famous singer, of an older generation, comes back into the limelight. Ezio Pinza, famed operatic bass turned musical comedy idol, lavishes his great voice on "Into the Night" and "Give Me Your Hand" on Columbia, LC35. In the more up-to-date popular vein Bill Doggett is both jaunty and amusing on his two-sided "Honky tonk" organ record (NZP55), and from Britain come Dave King and the Keynotes to entertain with "The Birds and the Bees" and "Hotta Chocolotta" (45-F 10741). Winifred Atwell is as usual in "Left Bank" and "Rampart Street Rock" on 45-F 10762, and Johnny Brandon has a good version of the amusing "Glendora" on F10778. There is stirring music from the Central Band of the R.A.F. on HR10285, with the "Reach for the Sky" theme and a number called "The Jolly Airman". The former turns up also in a version by Billy Cotton on F10767, with its backing "Whatever Will Be, Will Be". In addition, the HMV group are featuring a large Rock and Roll list, from

Parlophone, London, and Capitol originals. The artists to be heard in this batch include Boyd Bennett's Rockets (try "Rabbit Eye Pink and Charcoal Black" on NZP52), Skeets McDonald ("You Oughta see Grandma Rock", on Capitol 3461) and also Chuck Berry who, I am pained to see, does a "Roll over Beethoven" on NZL110.

LPs in the light vein include a positive piano marathon from our old friend Charlie Kunz (Decca LK4131). This is politely called "Mr Charlie Kunz at the Piano" and is a traversal of old time music hall songs, according to the label there are no fewer than thirty-six of them, which is surely value for money. There is even a leaflet giving all the words, an excellent idea and a decided encouragement to use the disc as the accompaniment for an old-fashioned party sing-song. You should also enjoy Mantovani's "Favourite Melodies from the Operas" (LKM4127) and Frank Baron's disc of tunes from "The Eddie Duchin Story" on MGM MC6007.

When the Vienna Opera House reopened late in 1955, one of the ambitious new productions was of an enormous Richard Strauss opera, "Die Frau ohne Schatten" ("The Woman without a Shadow"), which had been first performed in 1919. The music is Strauss at his richest, though the story is extremely involved and full of fantastic symbolism, so much so that I hope Decca will produce a libretto to supplement the admittedly elaborate notes provided on the covers of the five discs (LXT5180-4). This complete recording is by the Vienna opera cast under Karl Bohm. It is wonderful that such a work should be recorded at all, and Strauss fans will doubtless be wondering if they can afford it: provided they really like Strauss it would be money well spent. In the principal roles are Leonie Rysanek, Christel Goltz, Elisabeth Hongen, Hans Hopf and Paul Schoffler, and many quite famous names are listed as singers of smaller roles in the huge cast. Other Deccas give us music on a much less heroic scale. Pianist Wilhelm Kempff plays a really charming recital of small Handel and Beethoven pieces on LW 5212, Van Beinum conducts the picturesque "Four Sea Interludes" from Britten's "Peter Grimes" on LW5244, and at long last there has appeared a really successful version of the Vaughan Williams song cycle "On Wenlock Edge", a work notoriously difficult to record properly. The protagonist, on LW5233, is the Canadian tenor George Maran, well known as the tenor in Decca's complete "Messiah" recording; in the Vaughan Williams he performs with the London String Quartet and the pianist is Ivor Newton, a famous accompanist of the old school whose appearances on modern discs have been far too infrequent.

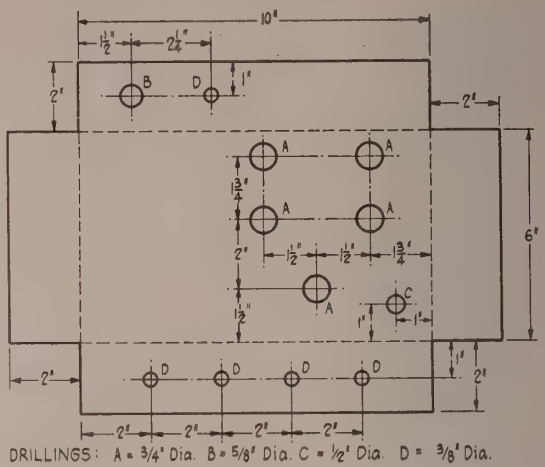
One of the last and best of Toscanini's recordings was a splendid version of the prologue to Boito's opera "Mefistofele". This opera, based on far more of Goethe's "Faust" than was used by Gounod in his much better known setting, opens with the scene "In Heaven" where Mefistofele, or Satan as he is better known to us, challenges God, and the result is music of quite extraordinary breadth and power. With the Robert Shaw Chorale, the Columbus Boychoir, and the excellent bass soloist Nicola Moscona, Toscanini secures an electrifying performance. The other side of this impressive record holds Verdi's "Te Deum", one of four short sacred pieces which were almost his last compositions. The number of this important issue is HMV ALP1363.

Julius Katchen will, we hear, be back with us this year. Hardly any pianist since the war has caused such a sensation with the musical public in New Zealand, and there has, of course, been a steady demand for his records ever since his visit in 1955. Two new ones will therefore command great interest. There is Decca LXT5187, with its coupling of Beethoven's F minor "Appassionata" sonata with the last one of all, the C minor, opus 111; this will be very welcome to those who heard him play both works. On LXT5164 Katchen adds his contribution to the already growing pile of discs traversing Tchaikovsky's B flat minor concerto. There are many good versions of this and it would be foolish to claim that they are all necessarily displaced, but what puts the record in an exceptional class is the fact that, in addition to the Tchaikovsky Decca have also found room for the whole of Liszt's "Hungarian Fantasia", which is an elaboration, for piano and orchestra, of one of the better known of the Hungarian Rhapsodies. The orchestra in both works is the London Symphony under the Italian teenager Pierino Gamba, who first achieved fame some years ago as a child prodigy conductor.

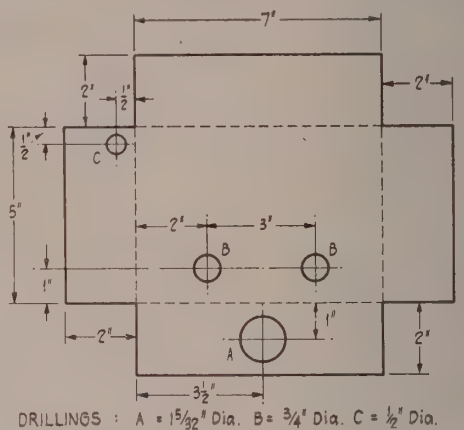
Connoisseurs of British music will welcome the first recording of the new Arthur Bliss violin concerto, as played by Campoli and the London Philharmonic Orchestra under the composer on LXT5166. More cautious music lovers may like to be assured that the music is not in the least "difficult", for Bliss has written a rich and romantic work which, they will find, makes for thoroughly satisfying listening.

High-quality Amplifier

(Continued from page 23)



DRILLINGS: A = ¾" Dia. B = 5/8" Dia. C = ½" Dia. D = ⅜" Dia.



DRILLINGS : A = 15/32" Dia. B = ¾" Dia. C = ½" Dia.

Working drawings for the two chassis for amplifier and power supply respectively.

SPECIALISTS IN A
SPECIALIZED FIELD.
MR. SERVICEMAN.
Our Universal Coils, types 40 (Aer)., 45 (R.F.) and 41 (Osc) will replace any damaged R.F. Coil.
Inductance Specialists
THE N.Z. HIGH FREQUENCY SPECIALISTS
262 TORRISDON QUAY, WELLINGTON, N.Z.
COILS, I.F. TRANSFORMERS H.F. CHOKES, B.F.O.'s DIALS, SCALES, COIL ASSEMBLIES, GANGS, BUILT-UP UNITS, ETC

ELECTRICAL AND TRADE SECTION

TV OR NOT TV?

The answer to this thorny problem is undoubtedly bound up to a considerable degree with the cost of establishing and maintaining a service. This article presents a typical estimate, made by a firm well qualified to do so. It takes into account not merely the setting-up of a few stations in the main centres but the provision of a service to a sizeable proportion of the country's population.

There is no doubt that a major obstacle to New Zealand's obtaining its own television broadcasting service is finance. Whatever way we may look at TV, whether with favour, or with a jaundiced eye, it is impossible to be realistic about it if we ignore costs, both capital and recurrent. The following estimate was made by Messrs Philips Electrical Industries of New Zealand Ltd., as the result of a close study of the relevant factors by Mr Dirk Hudig, the company's Managing Director. We quote from Mr Hudig's report as follows:

"There are four major items to be considered. These are—

"1. Transmitters.

"2. Studio equipment.

"3. Long-distance links.

"4. Programme material

(a) Films

(b) Live shows

(c) Commercials.

"These are examined in detail below.

1. Transmitters

(a) The cost today of a fully equipped major transmitter, inclusive of aerial and buildings, would be approximately £105,000. For New Zealand, four of these stations could possibly be needed.

The kind of transmitter referred to would have an effective radiated power of 60 kilowatts, and would cover an area of 40 to 50 miles radius (2,000 square miles). In this estimate, a 500 ft. self-supporting aerial tower is taken into account.

(b) Secondary transmitters serving six smaller country centres could be established at a cost of £37,000 each. This kind of transmitter would have an effective radiated power of 2 kilowatts, a 150 ft. self-supporting tower, and a small building for the transmitter.

2. Studio Equipment

(a) For major studios, contained in a building of 500,000 cubic feet, the cost would be approximately £400,000 each. This figure takes into account land, building, three camera chains, lighting systems, stages, control equipment, film scanners (both 35 and 16 mm.), news booth, interviewing booth, and an outside broadcast vehicle with its own cameras and associated equipment.

(b) Smaller studios, of 150,000 cubic feet capacity, with two camera chains, film scanners, O.B. van, and interviewing and news booths, would cost £150,000 each inclusive of land and building.

The money involved in 1a, 1b, 2a, and 2b, adds up as follows:

4 major transmitters (Auckland, Wellington, Christchurch and Dunedin).....	£420.000
6 smaller stations	£222,000
2 main studios (Auckland and Wellington)	£800.000
2 smaller studios (Christchurch and Dunedin)	£300,000
Grand Total	£1,742,000

3. Inter-station Links

There are two practicable ways of linking TV stagramme material. One is by co-axial cable, and the other is by radio, using highly directive U.H.F. or V.H.F. transmission. In mountainous country, subject to earthquakes, co-axial cable is too difficult and expensive to maintain, and there is little doubt that for New Zealand, the most economical links would use U.H.F. radio transmission. The system of stations listed above would need 1200 miles of two-way radio links, and about 24 relay stations. This would cost about £480,000, inclusive of gear and small buildings to house it. This would bring the total capital cost of £2,222,000.

4. Programme Material (Film Programmes)

Filmed programmes can now be obtained in quantities from most English-speaking countries throughout the world. Major libraries can be found in England, Canada, and the United States, and now that Australia has its own TV service, programme companies there are producing TV programmes on film. The price of these programmes is, of course dependent on length, production cost, quality of artists, etc.

5. As a guide to overall programming costs, the rates at present charged to Australian sponsors of commercial TV programmes are given below:

Class of Time	One-minute Spot	Rates for Series of 13	Series of 52
'AA' Time	£A.51*	£A.663	£A.2496
'A' Time	£A.41	£A.553	£A.2028
'B' Time	£A.30	£A.390	£A.1456

Note: 'AA' Time, Mondays to Fridays, 6.59 to 10 p.m.
'A' Time, Mon. to Fri., 4.59 to 6.50 p.m.; Sat. and Sun., 11.59 a.m. to 6.59 p.m., and 10.00 to 11.30 p.m.
'B' Time, all time other than 'AA' or 'A'.
*£A.1 = N.Z. 16s.

6. Operating Costs

Excluding the cost of operating the studios (which should be charged against programme cost) the cost of running each major station would be £15,000 p.a.

A main studio, operating for 1500 hours per year would be approximately £600,000 p.a., inclusive of film programmes, personnel, artists, and properties.

All in all, a New Zealand-wide service in full operation would cost approximately £2,500,000 a year to run."

After presenting these estimates, Mr Hudig comments further:

"On looking at these figures, the question of 'How do we pay for it?' automatically comes up. With the exception of the United States, all countries that have TV today have at least one chain of government-owned stations. In some cases, there is government-owned TV with, and in some cases without the same of commercial time. In Australia, there is a mixture of government-owned non-commercial, and privately-owned commercial TV, just as there is now in the United Kingdom.

"If therefore the question of TV for New Zealand is considered, it is clear that we could have either Government-owned, commercial, non-commercial, or both. There could also be privately-owned commercial TV, or any combination of the three."

"If we investigate figures from other countries in which TV has already been established, a reasonable forecast would be that in the fourth year of operation, 150,000 homes would be equipped with receivers. If a viewing fee of £5 p.a. were charged, this would result in an income of £750,000 per annum. Further, if a total of 800 hours TV broadcasting per station per year is achieved, and if 25 per cent of this, i.e., 200 hours per station per annum were paid commercial time, we can calculate as follows:

4 major stations (200 hrs. @ £150 per hr.) ...	£120,000
6 minor stations (200 hrs. @ £75 per hr.) ...	£90,000
Total commercial revenue	£210,000

"Thus, total revenue from viewing fees and the sale of time to sponsors can be estimated at £960,000. Comparing this with the operating costs, estimated in paragraph 6, above, we find that there is still a deficit of £1,440,000. The question then, is this: Would not an expenditure of about £1½ million pounds a year—a very small fraction of the national income—be well spent on this latest medium of home entertainment and instruction?"

"SOLARTRON" NOW REPRESENTED IN NEW ZEALAND

One of Britain's newer, but most progressive firms in the field of electronics is the Solartron group of companies, now represented in New Zealand by Messrs E. C. Gough Ltd., of Christchurch.

Commencing in business as late as 1950, the Solartron Electronic Group Ltd., and its associated companies have had a meteoric rise, which shows no sign of flattening off! A brochure issued by the company in 1955 shows that the monthly turnover rose from a figure of approximately £3000 in 1950 to £48,000 in 1955. Total assets of the group rose from a very modest figure in 1950 to £425,000 in 1955, and during the same period, the number of people employed rose from 25 to 425. Sales for 1955, the brochure states, exceeded the total for all previous years added together.

It is apparent that the group, which operates under Dr. J. E. Bolton, S.Sc., M.A., M.B.A., as founder and chairman of directors, is an extremely efficient and well-knit concern, in which a variety of specialized activities are carried out by its own separate organization within the group. The Solartron Electronic Group Ltd. provides commercial, financial, accounting, personnel, training, organization and methods, and maintenance services for the operating companies. Solartron Research and Development Ltd. undertakes research and developmental work connected with the design of electronic equipment for manufacture for other Solartron companies. Solartron Laboratory Instruments Ltd. manufactures Solartron electronic instruments and specializes in batch-quantity production. Solartron Engineering Ltd. undertakes precision engineering work associated mainly with the electronic and aircraft industries, and specializes in model shop and small quantity production. This company also supplies the mechanical engineering requirements of the rest of the group. Finally, Solartron Electronic Business Machines Ltd. has been formed to undertake research and development in the data processing field.

From the above, it is obvious that the group practises what it preaches through the medium of their well-known "Dr. Frittertime" advertisements in the electronics press.

Of greatest interest to readers of this journal will be Solartron's range of instruments, which ranges from general-purpose oscilloscopes to highly specialized test instruments for allowing unskilled operators to run acceptance tests on complete servo-mechanisms.

TRADE WINDS

At the recent agricultural aviation show in Palmerston North, Pye (N.Z.) Ltd. exhibited a wide range of appropriate equipment, much of which is actually in use by topdressing operators. Included were a number of types of V.H.F. communication equipment, one of the most interesting of which is a small and light outfit worked from dry batteries, for installation in gliders. Also on display was a transistorized loud-hailer with a range of up to half a mile.

E.D.A.C. ON A WIDE RANGE OF ELECTRONIC PROJECTS

Firmly establishing itself as an important unit of the country's electronics industry is the Electronic Development and Application Company. This company is independent of, but associated with Philips Electrical Industries of New Zealand Ltd., and under the guidance of Ralph Slade is becoming well known among users of electronic equipment as the most up-and-coming concern in the field, with both the engineering knowledge and the equipment to tackle not only the design of electronic equipment but also the scientific applications of electronic techniques to the problems of industry. The company is undertaking such work as the carrying out of strain-gauge measurements on new structures, and has already done much to relieve the Dominion Physical Laboratory of this work. One very successful piece of design work E.D.A.C. has carried out is a line-fault locator which displays on a cathode ray tube information concerning the exact whereabouts of faults on lines many miles long. Another job in an entirely different field that is currently under investigation is a method of making electric fences self-testing, so that their operation can be automatically checked from a central position, without carrying out a detailed inspection of miles of fences. In addition, E.D.A.C. has recently carried out several successful projects for industrial firms, who had problems that could only be solved by the application of electronics.

NEW ZEALAND PRODUCTION OF CERTAIN HOUSEHOLD APPLIANCES, 1955-56

Preliminary figures show significant trends in the manufacture of some of New Zealand's more important household appliances.

By far the greatest increase took place in radio manufacture, the number of sets (including radiograms) made in the year, reaching 101,000 which is 18 per cent. higher than for the previous year.

Irons, electric ranges and refrigerators all recorded increases of 8 per cent. over 1954-55.

Production decreases over the previous year were recorded by radiators (28%), vacuum cleaners (24%), washing machines (21%), electric rangettes (17%), and jugs and kettles (10%).

NUMBER PRODUCED IN NEW ZEALAND

	1953-54	1954-55	1955-56*
Toasters	28,916	30,692	30,315
Irons	61,295	59,591	64.221
Jugs and Kettles	31,832	46,495	41,999
Radiators	42,107	40,170†	28.978
Vacuum Cleaners	36,183	41,273	31.399
Washing Machines	49,859	57,376	45,458
Refrigerators‡	44,693	66,053	71.491
Electric Ranges	25,375	28,707	31.049
Electric Rangettes	6,712	6,559	5.469
Radios	71,689	85,405	100,764

*Provisional.
†Revised.
‡Includes home and commercial refrigerators and freezers.

MR A. J. WYNESS CELEBRATES 25 YEARS' SERVICE WITH H.M.V. (N.Z.) LTD.

Mr A. J. Wyness

Just before Christmas a very pleasant function was held in the Royal Oak Hotel, Wellington, to celebrate Mr A. J. Wyness's 25 years' service with H.M.V. (N.Z.) Ltd., of which he is Managing Director. The luncheon was widely representative of H.M.V. dealers from all over New Zealand, and these, together with representatives of the radio industry as a whole, and of Government departments, such as the Post and Telegraph Department, the New Zealand Broadcasting Service, joined, over some good cheer presaging Christmas jollifications, and an excellent lunch joined in paying tribute to Mr Wyness, and to his work not only for his company, but for the whole radio industry.

Several speakers congratulated Jack on his achievement, and all joined in wishing him as good a second twenty-five years, and as much health and prosperity in it as he has enjoyed over the last twenty-five. On behalf of the firm, Mr Isaacs presented Mr and Mrs Wyness with a silver-mounted occasional table as a memento of the occasion. It was unfortunate that Mr A. Wyness, founder and first Managing Director of H.M.V. (N.Z.) Ltd. was prevented by ill health from being present at his son's 25th anniversary celebration. It was decided to reply to his telegram of apology, wishing him a speedy return to health, and enjoyment of his retirement, which was reported in this journal several years ago.

CLASSIFIED ADVERTISEMENTS

Rates 4d. per word, minimum charge 3s. Deadline date 1st of month preceding publication.

EICOnomise - Buy EICO INSTRUMENT KITSETS

GEORGE WOOLLER ELECTED TO INSTITUTE OF DIRECTORS

Mr George A. Wooller, of Auckland, has recently been elected a member of the Institute of Directors, England. One of the few New Zealand members of the Institute, Mr Wooller represents the interests of the Pye group of companies in Australia and New Zealand. Executive Director of the parent company, Pye Limited, Cambridge, England, he is chairman and managing director of Pye Limited, Auckland, and G. A. Wooller & Co. Ltd., Auckland. He is also chairman of Pye Pty. Ltd., Melbourne, Akrad Radio Corporation Ltd., Waihi, Green & Cooper Ltd., Wellington, and a director of Tecnico Ltd., Sydney, Bendix-Tecnico Pty. Ltd., N.S.W., F. W. Davey & Co. Pty. Ltd., Victoria.

TRAVELLERS' VIEWS ON TV AND OTHER THINGS!

New Zealand dealers will be interested in several observations on overseas trading made by Leighton Lord and Dirk Hudig, of Philips Electrical Industries of New Zealand Limited, who have just returned from an extended trip to Canada, United States, England, Holland, and other countries en route. Both Leighton Lord and Dirk Hudig were impressed with the progress that has been made overseas in the TV field. Many Philips retailers were called on in the above countries, and it was noticed that they were selling all brands of radio, TV sets, shavers, records, white goods, etc. Trade was extremely competitive. A considerable amount of money was being spent on advertising, outside salesmen, and in making shops attractive to customers. As much as 18 per cent. of the dealer's buying price of most products was being spent on capturing the customer. Discounts were common with many dealers in the United States—some offering as much as 30 to 35 per cent. discount on certain lines. Time payment, particularly in the United States and Canada, was big business. Without time payment, sales of all radio, TV, and electrical goods would be infinitesimal. It was noticed that 10 dollars deposit on a 600-dollar radiogram was common, but, if a person was known, no deposit was necessary. The American citizen was exhorted to buy on time payment everywhere, and for everything. One finance executive of a department store in the United States confided to Leighton Lord and Dirk Hudig that the time-payment costs and charges practically paid the shareholders' dividends. Trade prices for TV receivers had recently been increased by about 10 per cent. in the United States, and some well-known TV manufacturers had actually stopped production because it was no longer economical to carry on in that highly competitive field. In England, on the other hand, the production of TV receivers was going along steadily, but customers were finding that the purchase tax was a difficult hurdle. The 50 per cent. tax is restricting sales. Everywhere Leighton Lord and Dirk Hudig went they found ready acceptance of Philips quality products, not only in TV but in radio, records, Hi-Fi equipment, shavers, and other products that Philips make and distribute.

Record Sales

The New Zealand travellers found that the sales of records in the United States were still on the increase. During 1957, manufacturers expected to sell

300,000,000 records, which represented nearly two per head of the population. There was a very definite trend in America in the record field. On the L/P side, mostly 12 in. records were sold, and 45 r.p.m. 7 in. single-play records were very popular. There was no demand for 10 in. L/P records, and it was interesting to notet hat 78 r.p.m. records had almost disappeared from the American scene. The public demand for 16⅔ r.p.m. record "talking books" was negligible and were almost extinct. As record retailers in the United States put it, "apparently people here talk enough and hear enough talk during the time, all they want is good music at night." Music is not put on 16⅔ r.p.m. records as the quality is too poor. It was noted that diamond styli were now used extensively because it has been realized by the publict hat only a diamond stylus can save wear on valuable records.

As for high fidelity, it was noticeable that retailers everywhere were enjoying big sales of this popular equipment. The public were selective when it came to choosing the types of speakers and amplification equipment to be installed in their homes. The so-called "membrane tweeter" speakers did not seem to have the acceptance they had ay ear ago. On the Continent Leighton Lord and Dirk Hudig noticed that Philips "Bi-Ampli" (separate high and low-tone reproduction with Philips 800-ohm high-impedance speakers) were widely accepted, and quick inroads were being made witht his equipment into the American market.

THE NEW ZEALAND MOA STRUTS ABROAD

Dirk Hudig and Leighton Lord are installed as president and associate member, respectively, of of the Moa Sales Club.

The photographs on this page show that the supposedly extinct and exclusive New Zealand moa is back to life again. Philips New Zealand have revived the moa and have formed what they call the "Moa (pronounced 'More') Sales Club." Dirk Hudig was inaugurated as the president of the club and Leighton Lord has been made an associate member. While Dirk Hudig and Leighton Lord were in the United States, England, and Holland, these active representatives of the New Zealand Moa Sales Club helped

Just to show that there is no deception, here are Leighton Lord, Dirk Hudig, Ivan Webb, and Maurie Harding convincing the leader of a spate of moas that Philips products are best, even in the high moa country.

to publicize New Zealand wherever they went. Philips top executive, Mr O. M. E. Loupart, was made the first Honorary Member of the Moa Club, and was handed an official seal of authority in the form of a rubber stamp bearing a design which represented the footprint of a moa. Incidentally, when any member of the Moa Sales Club sees this moa foot seal at the bottom of a letter, it means "more action, please."

AUTOMATION

Those New Zealanders who have been reading about automation in England and America will be interested in a few impressions on this new development. Labour-saving devices were demanded everywhere, not only in the home, but also in factories and public utilities. For instance, automation was very evident at the new Philips factory at Croydon, England. This factory, which can produce many hundreds of thousands of TV and radio sets every year, had a fully automatic ceiling and floor transportation system. This system brings picture tubes, cabinets, and sub-assemblies from different floors to the assembly hall. The ceiling-supported "hanging railway line" brings parts to each worker at the exact moment he requires them. Leighton Lord and Dirk Hudig were impressed with the fact that no one had to lift or carry anything any more. Floor-mounted transport

belts automatically separated sets which had passed all quality tests from sets that were not up to the right standard. These faulty sets were automatically fed back to work benches and testing rooms, where they were further inspected. Employees worked under excellent light and air-conditioning. There were several main production halls, each of 40,000 square feet; canteen facilities were excellent. Several vehicle parks for employees were provided in the factory grounds to ensure quick access without wasting time.

AUTOMATION AT "LA GUARDIA" AIRFIELD

When Philips New Zealand representatives arrived at La Guardia airport in New York, one of the most impressive features of this modern airport was the fully automated passenger booking service. Dirk Hudig explains the system as follows: "You go up to the desk and you ask the clerk for two reservations on, say, Flight 500. The clerk takes a pre-punched card out of this flight number and pushes it into a slot. He then pushes a button numbered 2 (if you require two reservations). If a green light comes up it means that your booking is confirmed by the Central City Booking Office. If ar ed light comes up, it means that all seats on that flight have been sold. All this happens in seven seconds. When he writes the names of the passengers on the tickets the names are automatically transferred via a "transcriber" to the Main City Booking Office and the seat numbers are automatically written to the booking clerk via another transcriber, which is in front of his eyes. Luggage is weighed under the booking clerk's counter. As soon as the weight of the luggage is known, a button is pushed and all luggage disappears down below to the luggage sorting and routing floor. The luggage lift returns again to receive more luggage from the booking clerk within a matter of five seconds."

Both Leighton Lord and Dirk Hudig have gained a tremendous amount of fact and knowledge during their six-month tour. Much of this will be used in the "streamlining" of production in the new £300,000 Philips Naenae factory which will open its doors in May, 1957, and in the Philips sales organization.

—♥—

PHILIPS TEAM RETURNS WITH CONCRETE PLANS FOR NEW ZEALAND TV.

Mr Dirk Hudig and Mr Leighton Lord have returned from their overseas tour with definite plans for how a national TV service can be established at reasonable cost.

They visited Europe, Canada and America to make a close study of the many different kinds of TV networks now operating, gathering concrete data on the costs of installation and running.

As a result, the Philips team has offered a practical outline for a New Zealand TV service.

Mr Hudig estimates that it would cost £2,500,000 to establish the service. This would cover the building of ten stations, linked by a 1200-mile hook-up between the main centres and provincial cities such as Palmerston North, Hamilton, and New Plymouth. The network will involve a running cost of about £2,500,000 annually.

A welcome feature of Mr Hudig's plan is that it does not unduly favour any one of the main centres, although it proposes Auckland as the site for the central studio. There would thus be no question of one city being the first to have TV.

"Newscasts can be shot separately according to regional interest," said Mr Hudig, "but it will be more practical to relay all major studio works."

Here are some of the main facts and figures given by Mr Hudig:

Cost of Auckland station with transmitter, tower and building, £105,000.

Cost of main stations at Wellington, Christchurch, and Dunedin, £75,000 each.

Studio equipment in four main centres, including building and cameras, £400,000.

1200-mile hook-up linking four main centres with 24 relay hops—between £450,000 and £500,000.

Construction time to complete the network, 2½ years.

Network to consist of four main stations, two main studios, two smaller studios and six provincial stations.

Television receivers to be constructed locally and sets with 17 in. tube would probably be retailed at between 120 and 130 guineas. (Philips new production centre at Naenae will have a production line for television receivers).

Control. Mr Hudig favours Government control with major stations partly commercial, partly national. Commercial programmes might form from a quarter to half of the transmission time.

Revenue. Raised by the advertising fees, thus avoiding otherwise impossibly high licence fee.

Transmissions. Monochrome much preferable to colour since the latter costs four times as much to advertiser, operator and viewer, and is still suffering growing pains.

Programmes. An ample supply of inexpensive good-quality television films is available from overseas libraries and Mr Hudig is confident that the opportunities in live programmes will encourage local producers and artists, who are already achieving a high standard on radio, especially in documentaries.

BACK NUMBERS OF "R. & E. R."

BACK NUMBERS ARE AVAILABLE FROM:

S.O.S. Radio Ltd., 283 Queen Street, Auckland.

S.O.S. Radio Ltd., 1 Ward Street, Hamilton.

Webb's Radios Ltd., 11 Wellesley St. E., Auckland.

Tricity House Ltd., 209 Manchester St., Christchurch.

Ken's Ltd., 142-144 Stuart Street, Dunedin.

Fear's Radio and Cycle Co. Ltd., 31 Willis Street, Wellington.

The Radio Service Co., 83 Guyton Street, Wanganui.

Technical Book and Magazine Co., 295-299 Swanson Street, Melbourne, Australia.

NEW PRODUCTS: LATEST RELEASES IN ELECTRICAL AND ELECTRONIC EQUIPMENT

This section of our paper is reserved for the introduction of new products and space preference is given to our regular advertisers. For further particulars contact Advertising Manager, R. & E., Box 8022, Wellington.

LATEST PYE RADIOGRAM

"FAULTLESS"

Perhaps the dealer who said he could not find fault with it anywhere was over-praising the new 500R.G. Then again, perhaps he wasn't! This new Pye radiogram certainly seems to meet all the requirements of a critical public and to provide them with many of the fine details that often lift a Pye model so near to perfection.

In circuit design this otherwise conventional 9-valve (counting the magic-eye) bandspread radiogram features dual loudspeakers with a cross-over frequency network. The 10 in. and 5 in. speakers give faithful reproduction over an extraordinary wide range of frequencies. The waveband coverage is the broadcast band plus medium shortwave (8.0 —3.2 mc/s.) and the 13, 16, 19, 25, and 31-metre bands. The record-player is the de luxe Garrard 3-speed automatic changer incorporating a turnover crystal cartridge.

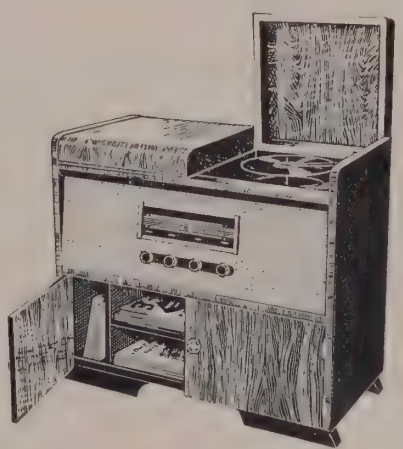
A considerable advance in design is shown in the cabinet of the 500R.G. (as seen above) and it is available in walnut at £139 15s. or luxurious mahogany at a slightly higher price. A most attractive contrast is provided by the lighter-coloured woods discreetly used in various places; the inside of the gramophone compartment, for example, is finished in sycamore, which gives an air of spaciousness, almost of indirect lighting, to this compartment.

Cabinet dimensions of the Pye 500R.G. are 35½ in. x 17 in. deep x 35 in. high, and record storage space is more than adequate. Sales of the 500R.G. should be very steady indeed and Pye dealers would be wise to ensure that the model gets the publicity it deserves.

Distributors of the 500R.G.: Pye Ltd., Head Office, P.O. Box 2839 Auckland, and Branches at 43 Lower Taranaki Street, Wellington, and 16-18 Victoria Street, Christchurch.

ANOTHER NEW CLIPPER RADIOGRAM

Clipper Model 6G2



The Clipper Model 6G2, while having no similarity in looks to the 5R2, also offers unusual features in cabinet design. In the case of the 6G2 the dial scale and tuning knobs (as can be seen in the illustration) are on the outside of a handsomely designed walnut cabinet. This enables the listener to operate the radio without opening and shutting the cabinet to make small adjustments. On the other hand, the record changer is well concealed when not in use under a lift-up lid.

For convenience alonce, the cabinet offers many advantages, and once again the design lends itself (or has been adapted to suit) an unusual loudspeaker arrangement. In this case, twin 8 in. high flux speakers are placed high in the cabinet, one on each side of the dial scale. This positioning of the loudspeakers gives a much more regular diffusion of sound through-

(Concluded on page 46)

ATLANTIC NOW SPANNED BY TELEPHONE

For the first time, Western Europe and North America are now linked by a direct telephone cable giving a weatherproof system capable of carrying 36 simultaneous conversations unhampered by atmospheric conditions.

The 8000-ton British cable ship "Monarch" landed the final length of the 2500-mile length of cable, the world's longest, at Clarenville, Newfoundland. The new £15,000,000 cable makes it possible to call Ottawa, New York, or other American and Canadian cities with the ease of making a toll or trunk call in one's own country.

It was expected that the Montreal to London telephone cable circuits would be in operation about the middle of October. All tests will be completed in about six weeks' time, after which there will be an official opening.

The work was undertaken jointly by the British Post Office, the Canadian Overseas Telecommunications Corporation, the American Telephone and Telegraph, and the Eastern Telephone and Telegraph Company.

Telegraph cables have spanned the Atlantic since 1866, but it was not until scientists solved the problem of perfecting a repeater which would withstand the great pressure of the ocean bottom that a direct telephone line became feasible.

•o•o•o•

AUTOMATIC PLANT FOR ATLAS 8 FT. TUBES

New automatic plant for the large-scale manufacture of Atlas 8 ft. fluorescent tubes has been installed by Thorn Electrical Industries at their Enfield factory. The need for the 8 ft. tubes is growing as a result of the increasing call for continuous lines of lighting and larger illumination areas.

The company have invested approximately £100,000 in the new plant, which is stated to be the first in Britain for the automatic production of the 8 ft. tubes. Very heavy exports are planned, and at the same time the home market demand is expected to increase steadily.

•o•o•o•

NEW MOBILE VISUAL EDUCATION UNIT.

In Washington, D.C., the Radio Corporation of America recently demonstrated the first visual education unit with its own power supply. The unit includes a gasoline-electric generator with a battery for self-starting, 16 mm. motion picture equipment, public address facilities, a tape recorder and a three-speed record player.

In public health, conservation programmes, military education, civil defence and other areas of teaching, this equipment is both practical and efficient for travelling visual education programmes.

In addition, it can be adapted easily for industrial uses. It has advantages in teaching production methods, safety techniques and sales training, and can lend a new dimension to sales and advertising campaigns.

All equipment of the RCA Mobile Visual Education Unit is installed in a trailer which can be attached to any vehicle. Its features include: rugged service, simplicity of operation, excellent performance in any climate or terrain.

•o•o•o•

MARCONI'S IONOSPHERIC SCATTER EQUIPMENT

Marconi's Wireless Telegraph Company Ltd., are now producing a new range of transmitters and receivers, specially designed for ionospheric scatter work.

The Ministry of Supply has already ordered a considerable quantity of the new equipment, including Type HS. 201 transmitters, Type HD.65 frequency shift drives and Type HR.16 double diversity receivers.

Both transmitters and receivers are designed to operate in the 35-55 Mc/s frequency band. The transmitters have a power output of 20 kW, the usual procedure being to operate two in parallel, using a split aerial system. The equipment is capable of sigh-speed operation, Frequency Shift keying being employed.

Some of this equipment will be used to establish a communications system between the United Kingdom and Malta, with an eventual extension to Cyprus and the Middle East.

Marconi's have also supplied a prototype transmitter to the Board of Admiralty for experimental work in ionospheric scatter propagation. This is a modified television transmitter with a power rating of 30-35 kW. sited at Gibraltar. The signals are beamed over the Bay of Biscay for scattering over Britain.

NEW IDEA FOR SELLING RECORDS—LONDON FIRM OPENS THE "BROWSERIE"

The opening of the "Browserie" at the "His Master's Voice" showrooms, Oxford Street, London, marked the application of the self-service technique of selling gramophone records on the most ambitious scale yet seen. The recently introduced "browser" boxes are used en masse in a 5,000 sq. ft. showroom equipped with every modern facility for selecting and hearing records and for the speedy handling of sales.

Look, Handle and Listen

The "Browserie" is a spacious, well-lit and air-conditioned hall with the central area filled with "browser boxes" holding approximately 20,000 records of all types, labels and speeds. Running around three sides of this hall is the newest idea in individual listening booths—33 of them altogether, not unlike artistically designed sentry boxes.

Finished externally in figured and polished veneers, and internally in a variety of soft pastel colours, these open-fronted structures are virtually sound-proof listening rooms. They are lined throughout with acoustic insulating material, and as one steps inside, the extraneous noise cuts off completely.

Each booth has a built-in amplifier and loudspeaker just above head level, with the volume control conveniently to hand. On a shelf outside each booth is a standard model 2126 record player, clearly marked with the record speed for which it is intended.

The "browser" boxes" are divided into 14 main sections, covering every type and category of record. Expert staff are also in attendance to advise and help.

* * * *

PYE INSTRUMENT LANDING SYSTEM

The new Pye Instrument Landing System incorporating many unique features is in super-priority production for the Royal Air Force.

The equipment is intended primarily as an aid to the landing of aircraft underconditions of bad visibility, but it is equally useful as a standard approach aid in all circumstances.

The system comprises a localizer transmitter which guides the aircraft directionally from at least 50 miles out to the centre of the runway; a Glide Path transmitter which guides the descent of the aircraft so that it makes contact with the beginning of the runway, and three Marker Beacons spaced along the approach path indicating the distance from the touch down point. All components of the system are controlled and monitored from a Remote Control Console normally sited at the airfield flying control.

Special features of the Pye System are the parabolic type Localizer aerial greatly increasing the accuracy, stability, and range of the approach course, the all-electronic design which dispenses with rotating parts, and the fully automatic fault alarm system including duplicate transmitters with monitors and automatic changeover which ensures complete dependability.

The Pye Instrument Landing System is so accurate that modern electronic automatic pilots can be coupled into the system to provide an automatic approach. In the present stage of development it is still necessary for the pilot to actually land the aircraft.

A REVOLUTION IN WIGS:

Philips are in the middle of a very ambitious project, the release of the complete works for piano by the great Johann Sabastian Bach. A fragile looking, extremely competent Viennese artiste, the harpsichord player Isolde Ahlgrimm, undertook to record the works (about 40 33 1/3 r.p.m. 12 in. records) in her charming, old-world Vienna home. The first releases—among which are the Wohltemperiertes Klavier, Book I, and the English Suites, have been received with genuine enthusiasm everywhere. Miss Ahlgrimm's interpretation is true to the spirit of Bach's music and the colour of the harpsichord renderings is caught beautifully in the recordings.

The husband of Isolde Ahlgrimm is Dr. Erich Fiala, a man who probably knows more about the music and personalities of Bach's time than Bach himself ever did. He is the compiler of the notes on the albums of this great Philips-Bach enterprise, is a keen book-lover and the proud possessor of a fortune in valuable editions, engravings and all sorts of interesting rarities. On the personal side Dr. Fiala is a lion in debate and a man of much wisdom.

Forever on the lookout for exclusive material in connection with his pet subject, one day he found an unfamiliar Bach portrait. He invited Philips to use it on the albums, duly warning them that this would be in the nature of a revolutionary act.

Now, going by the popular conception of Bach's looks it isn't Bach at all. The popular idea of his appearance is based on the famous picture done by the painter E. G. Haussman, in 1746, and since then copied in a million ways. Haussman presented Bach in the splendour of a curled, powdered wig, reminiscent of some of the great kings of France. He was a kingly man, Bach, but there is reason to believe that Haussman knew the art of touching up and, for example, possibly made Bach's nose less prominent than 18th century gossip said it was.

Dr. Fiala's Bach portrait certainly joins battle on the issue of the nose and furthermore, shows Bach with the braided wig which ousted the powdered variety in the fashionable circles of the time. Philips accepted Dr. Fiala's proposition. He proved that his unknown portrait of Bach, a glass copy of which was bought by him for peanuts, actually dates from Bach's lifetime. The original can be found in Kanth's repudiated Music History (1911), along with a portrait of Bach's first wife, Maria Barbara.

We think that Bach, crowned by a braided wig, looks jolly good on the Ahlgrimm albums.

And we've always had a sneaking admiration for revolutionary changes.

•• •• ••

WOOD DRYING BY RADIO

What is believed to be the world's first radio frequency heating plant for continuous wood drying on a conveyor system is now operating in Sussex.

The plant, developed and built by G. L. Freeman Ltd., in co-operation with Redifon Ltd, of Wandsworth, is being employed to dry birch billets for broomheads.

The billets are loaded into a gravity-operated magazine which feeds them on to a variable-speed conveyor belt of dielectric material. This carriers them through an electrode system, nine feet long, by one foot wide, which accommodates 30 billets at a time.

Each billet takes about an hour to pass between the electrodes, during which time about ¾ lb. of moisture is removed from each, and the moisture content reduced from 95% to about 35%. Should a lower moisture content be required the speed of the conveyor belt can be reduced accordingly. About two cubic feet of billets are processed per hour at a cost of 5/-.

The lower earthy electrode is placed beneath the conveyor belt and the live electrode just clears the top of the logs. A further earthy screened electrode is situated above the live electrode to give steady working conditions.

Tuning coils are fitted at various points along the system, and an impedance matching coil is fixed at the point where the radio frequency is fed into the electrode system.

Co-axial Feeding

Full use is made of the Redifon co-axial feeding arrangement which allows the R.F. generator to be placed in any convenient position. In this particular case the cooling air from the generators is directed along the conveyor and performs a most useful secondary purpose by carrying off the latent moisture driven out of the billets.

The generator used for this purpose is a 10 kW, Redifon R.H 11, operating at 19.5 megacycles per second. The cost of the plant is about £1500.

•• ••

TALKING CIGARETTE MACHINE

In Stuttgart (Germany) a cigarette slot machine has been installed which, after having supplied cigarettes, very politely thanks the customer by saying "Thank you very much. I hope to see you soon again."

Of course, such an invention is no world news, but nevertheless the German broadcasting service thought it worthwhile to interview this mechanical salesman. The Philips tape-recording installations inside the slot-machine had no "microphone fright" whatsoever, and the listeners could hear it recite dutifully the lesson it had learned by heart!

★ ★ ★

INTERESTING NEW APPLICATION

With the aid of the Philips X-ray image intensifier—which among other things has enabled the filming of organs within the human body—an extremely instructive film has been made which shows again the importance of the image intensifier for all ailing people. This 16 mm. sound film which lasts about 10 minutes, has been made by specialists of the University of Groningen (Holland), and visualizes a new method of speech-rehabilitation. Some patients have a disease which makes it necessary for

(Concluded on page 48)

Missing and Stolen Radios

Auckland:

Six volt "Autocrat" or "Pacemaker" car radio. Brown bakelite front, with a semi-round dial. Valued at £25. May be identifiable by general appearance. Serial number not known and not ascertainable.

Christchurch:

Philips mantel radio, cream in colour. Serial Nos. 81387 and 95487.

Twelve volt, 8-valve push-button car radio. Serial No. 33332 or 33496.

Twelve volt, 8-valve manual-tuned radio. Serial No. 33249.

Petone:

Philips Autoradio, Model 656, serial No. 2675, 4 valves, mottled grey in colour. The speaker was detached and was not stolen.

Rotorua:

Philco mantel model radio, 5-valve, brown plastic cabinet, serial No. 501-58862, value £24. Identifiable.

Wellington:

Pye portable radiogram, contained in dark blue case, with dark brown interior, recent model, number not known, but identifiable by a burn mark on the right front corner of the lid.

H.M.V. Mastertone portable three-speed record-changer and amplifier, Model 5509, size 14 in. x 15 in. x 9 in., in burgundy and check cabinet. Identifiable by serial number 1167.

Clipper car radio, 5 valves, painted grey, new condition; serial number 74738, and valued at £30.

HOME-MADE 6-valve broadcast mantel model, half-inch kauri cabinet 15 in x 8 in. x 8 in., off-gold speaker grille, broadcast dial, Rola speaker, 3 brown bakelite control knobs. Initials M. R. JONES cut into duralium chassis.

COURIER 1950, 4-valve broadcast mantel model; dark brown oblong dial; 6 in. speaker on left-hand side; light cream baklite cabinet, with two knobs. Red and gold transfer on rear of chassis; "Spence's Radio and Electrical Centre, Rotorua."

REGENT battery/electric portable, serial No. 32380; red plastic case, clear plastic handle; two control knobs.

PHILIPS five-valve dual-wave mantel model, serial No. 33924. Dark brown wooden case; four cream tuning knobs, with one missing.

PACIFIC 5-valve broadcast mantel model, serial No. 22244. White plastic cabinet, 12 in. x 12 in. x 10 in., with dial along top front edge and two white knobs.

BELL A.C. radio, serial No. 2437/78211. Maroon Cabinet 12 in. x 7 in. x 7 in., with square dial on right hand corner, three maroon knobs, open back, aluminium chassis.

PHILIPS mantel model 210, serial No. 15766. Brown wooden cabinet.

COURTELLA bedside 5-valve radio. Light walnut cabinet 15 in. x 10 in. x 8 in. with square perspex dial with red English figures on face; two plastic control knobs.

DOUBLE DECCA electric portable, brown cloth covered case, with plastic circular dial. Three bands. Transformer No. 18003.

AVALON 6-valve 12 volt car radio; brown plastic case with long narrow dial and tuning knob on either end. Dial covered with cracked clear plastic.

PACKARD auto radio 10 in. x 12 in. x 5 in. with separate speaker 6½ in. x 2 in.

LINCOLN FLETCHER radio-telephone, model 770, serial No. 133, Cab No. 96. Set 12 in. x 6.in. x 10 in. with separate power supply. Four white control knobs and Lincoln Fletcher name plate in front, 3 in. square speaker grille fitted in top right-hand corner. Aerial connection plugs on to front panel on top left-hand corner. No. 8 hand microphone with speaking pressall switch on side.

PHILCO mantel model 327, serial No. 34063, dark bakelite cabinet.

Two FIVESTAR beside radios, serial Nos. 33924 and 33887.

ULTIMATE auto radio. serial No. 155937.

ULTIMATE mantel radio, serial No. 160079.

Two ULTIMATE portables, serial Nos. 160920 and 160809.

CROMWELL Little Jewel, 5-valve broadcast, serial No. 75936/36452 in brown mottled case.

ULTIMATE 5-valve cream portable, serial No. 115295.

CROMWELL 6-valve broadcast mantel model, serial No. 24986, royalty No. 56603; dark brown wooden cabinet 15 in. x 12 in. x 10 in. Full length dial with three control knobs.

PHILIPS model 126, serial No. 51893, plastic cabinet with dial below speaker and two control knobs.

(Concluded on page 48)

out the room and consequently results in a considerable improvement in tone.

These techniques of design have in no way impaired the looks of the cabinet; on the contrary, "she's a real beaut," and fully deserving of popularity on looks alone. The capacity of the 6G2 for storing discs is remarkable, and the model will commend itself particularly to record enthusiasts. (The new Garrard 4-speed changer-player is incorporated.)

Other details are: 6-valve, dual-wave chassis with tuned R.F. stage; cabinet in figured walnut measuring 36 in. long, 32 in. high, 18 in. deep.

The very attractive retail price is £99 10s.

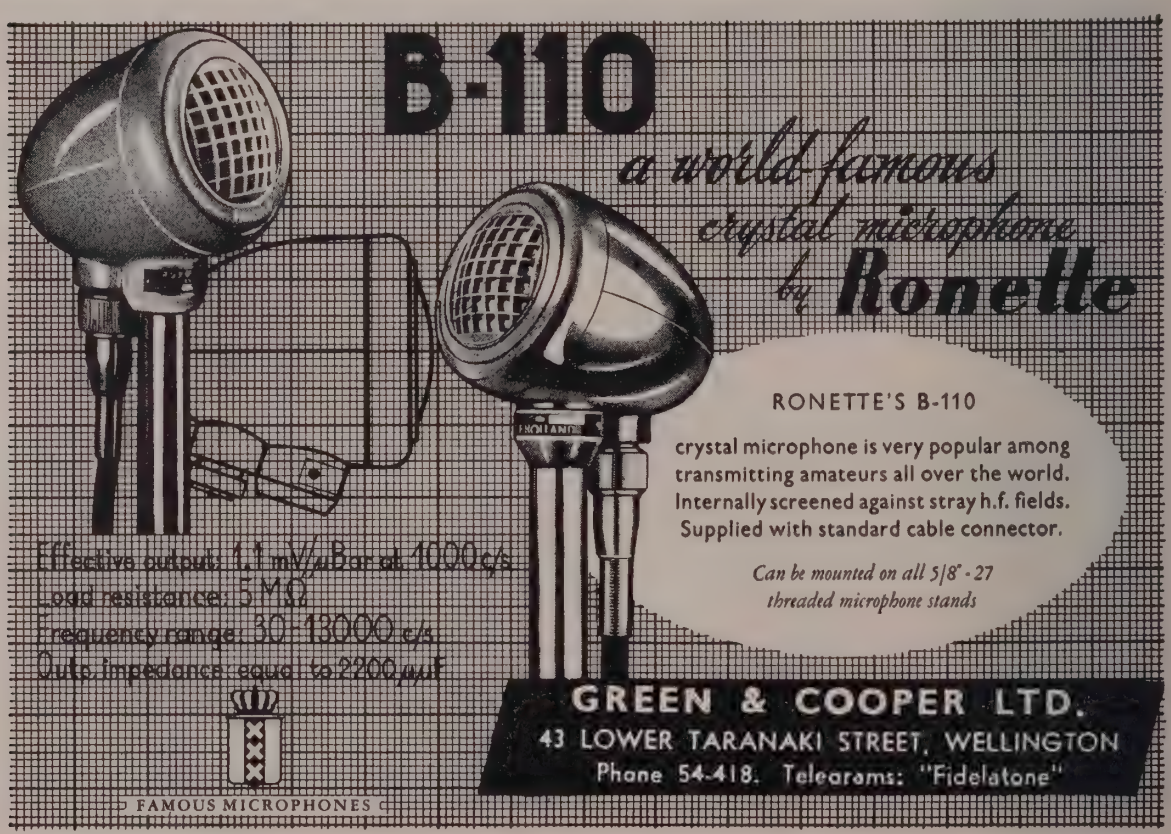
G. A. Wooller & Co. Ltd. are the distributors of Clipper models, and all radio dealers are invited to inquire for details of the full Clipper range at any of the company's offices: Auckland, P.O. Box 2839; Wellington, 43 Lower Taranaki Street; Christchurch, 16-18 Victoria Street.

CHANGE OF ADDRESS

Please note that Radio and Electronics (N.Z) Ltd. have changed their address, P.O. Box Number, and Telephone as follows:

Office and Laboratory:
48 ABEL SMITH STREET,
WELLINGTON.

P.O. BOX 6361, WELLINGTON.
TELEPHONE 50-660.


B-110
a world famous crystal microphone by Ronette
RONETTE'S B-110
crystal microphone is very popular among transmitting amateurs all over the world.
Internally screened against stray h.f. fields.
Supplied with standard cable connector.
Can be mounted on all 5/8"-27 threaded microphone stands
Effective output: 1.1 mV/μBar at 1000c/s
Load resistance: 5 MΩ
Frequency range: 30-13000 c/s
Cable impedance equal to 2200 μμF
GREEN & COOPER LTD.
43 LOWER TARANAKI STREET, WELLINGTON
Phone 54-418. Telegrams: "Fidelatone"
FAMOUS MICROPHONES

Circuits for Everyone in the

"R and E" Digest of Circuits No 3

price 3/6

In a digested form, this 88-page book contains basic constructional data on all the equipment described in "Radio and Electronics" and its successor, "Radio and Electrical Review," from February, 1951, to June, 1954, inc. As with the two previous Digests, the scope of this book is extremely wide, ranging from the simplest to the most advanced radio sets, amplifiers, test gear, etc. All essential data are given, together with references to the original descriptive articles which appeared in "Radio and Electronics."

NOTE: None of the material in "Digest No. 3" has appeared in the two previous Digests.

ORDER FROM YOUR NEAREST BOOKSELLER OR RADIO DEALER, OR FROM

RADIO and ELECTRONICS N.Z. LTD.

P.O. BOX 8022 WELLINGTON

AROUND AND ABOUT

(Continued from page 45)

their larynx to be taken away through an operation. This, of course, robs them of their power of speech. However, with great perseverance on their part, the patients may yet succeed in learning to speak with their oesophagus. The film shows the case of a man who has attained a high degree of perfection in speaking with his oesophagus. Every movement of this organ is shown very clearly, so that the film can be understood even by laymen.

The making of such a film—which is considered very useful from medical and psychological points of view—would be impossible without the aid of the image intensifier.

★ ★ ★

Redifon electronic welding equipment has been in continuous use by the motor industry to produce car door trims for a number of years. The trims, consisting of P.V.C. sheet welded on to fibre or bitumen board, can be produced in 7 seconds.

Seat backs are now to be produced by the equipment, and the first installations for the fabrication of complete plastic seat upholstery will soon be in use.

The simplicity with which the new-style upholstery can be cleaned will delight the car owner. It can be sponged down in a matter of minutes with soap and water.

The impact of this new development will, in all likelihood, extend beyond the motor industry. The years ahead may well see the large-scale use of welded upholstery for domestic furniture.

BACK NUMBERS OF "R. & E."

Available from our Office,

MISSING AND STOLEN RADIOS

(Continued from page 45)

SKYMASTER "COLT" 5-valve broadcast radio, serial No. 205; brown plastic oblong case standing on plastic legs; dial left front corner, separate variable tone control and three plastic knobs in front.

SKYMASTER "DE LUXE" 6-valve broadcast radio, serial No. 22976. Tropical proofing walnut veneer cabinet; 8 in. speaker with extension speaker terminals; four tuning knobs; dial front bottom.

HAMILTON:

PHILCO A.C. battery portable, serial No. 22736. Brown rexine cabinet 12 in. x 10 in x 2½ in., brown bakelite sliding dial, two tuning knobs, 1 in. wide brown leather shoulder strap.

Regent CHANCELLOR 3-speed 4-valve A.C. radiogram, serial No. 40152, model No. 4G2. Polished walnut veneer cabinet 10 in. x 14 in. x 16 in.

PUTARURU:

ULTIMATE 6-volt, 7-valve auto radio, serial No. 143764 RBN. Green and brown cabinet with white buttons.

TE AWAMUTU:

FORD 6-valve car radio serial No. 7591; grey metal cabinet 9 in. x 7 in. x 4 in. Brown plastic dial, two white tuning knobs; separate speaker in grey metal case 7 in. x 7 in. x 4 in. with one tuning knob. Chrome whip aerial.

MORRINSVILLE:

CRUSADER 5-valve broadcast mantel model, serial No. 6829. Brown walnut veneer cabinet 18 in. x 12 in. x 9 in., oblong dial.

MATMATA:

SKYMASTER "COLT" 5-valve broadcast radio, serial No. 2374. White plastic cabinet 10 in. x 6 in. x 6 in.

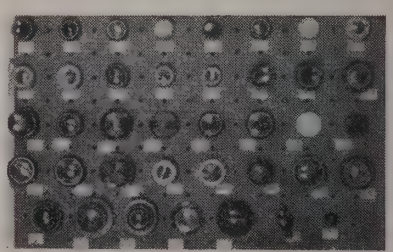
ROTORUA:

PACEMAKER A.C./battery 6-valve portable, serial No. either 15868 or 18367. (One royalty No. other serial No.). Maroon plastic case with slight scratch on right-hand corner.

PACEMAKER portable, serial No. 27432. Wine plastic cabinet 10 in x 10 in. x 6 in with white or ivory lid and handle. Radio plays on opening lid.

COLUMBUS mantel model 90, serial No. 81318 fitted with extension speaker switch at back of set.

KNOBS! KNOBS! KNOBS!
. . . NOTHING BUT KNOBS



WE CARRY THE LARGEST RANGE OF RADIO KNOBS IN NEW ZEALAND

All shapes and sizes, large and small, light or dark, all fitted with grub screws and metal inserts.

The best and cheapest knobs in New Zealand.

Make sure you get a good selection. If you cannot see any suitable ones here, write to us for other types.

Remember—

FRED ROTHSCHILD & SON

79-83 PRETORIA STREET, LOWER HUTT.
P.O. Box 170 — Lower Hutt.

YOUR Radio Wholesalers

FOR THE SERVICEMAN

SERVICE INFORMATION ON THE "EDITOR" MODEL A13 PORTABLE TAPE RECORDER (CONCLUSION)

(Information kindly supplied by C. & A. Odlin Ltd.)

SERVICING

To remove recorder from cabinet. Unscrew four rubber feet from bottom of cabinet. Remove cabinet lid. Lay recorder face down on bench and lift cabinet away from recorder. Recorder is complete in frame assembly.

To remove tape deck unit from frame assembly. Remove five control knobs, 4BA round head screw from centre of top plate and sound head dress covers. These are pin-located on top plate under tension. Lift off top plate. Remove four 4BA screws from top of tape deck unit. Unplug record head lead, erase head lead and tape deck mains lead. Lift off tape deck unit.

Maintenance. Clean both heads using a soft piece of material wrapped round an orangestick. It is important to do this regularly as a coating of oxide or dirt on the heads will cause low output and poor erasure.

Pinch wheel should occasionally be very lightly lubricated with thin machine oil. Ball bearings at top and bottom of flywheel should be lightly oiled. Keep oil away from pinch wheel rubber and capstan surface at all times. Motors have built-in oilers and should not normally require attention.

After some months of use, according to the amount of usage and grade of tape used, the pinch wheel may become shiny and require resurfacing. To do this hold a piece of superfine emery paper very lightly against the rubber whilst it is rotating and remove shiny surface

Access to the heads and capstan assembly can be obtained by removing the head cover. To do this place your hands at either end of the cover. A slight inward pressure will free the fixing pins from their locating holes and cover can then be removed.

Wow. Irregular speed variation is caused by insufficient pressure between pinch wheel and capstan. Pinch wheel pressure spring, located underside of tape deck, may have become broken or unhooked.

Irregular speed variation caused by binding of pinch wheel on pinch wheel shaft. Insufficient lubrication of pinch wheel bearing. Fill pinch wheel reservoir with castor oil and ensure bearing is free. Note: mineral oils should not be used since they distort the rubber.

a quality British product

Hi-Craft LAMPS & TUBES

All the engineering skill and experience of Britain's largest old-established manufacturer results in the almost perfect HI-CRAFT Lamps and Tubes. A complete range of sizes and types IS NOW AVAILABLE IN NEW ZEALAND.

NEW ZEALAND DISTRIBUTORS:
HAMER ELECTRICAL CO LTD.
AUCKLAND, CHRISTCHURCH, DUNEDIN.

Speed variation caused by feed spool binding. Ensure spool is not warped and touching top plate. Check feed spool motor bearings. Check feed spool brake is clear when running.

Speed variation or slow running. Caused by drive pulley slipping on shaft of centre motor. Tighten grub screw in pulley and check speed changeover operation.

Brakes. Brake failure: brakeband broken, replace. Brake weak: increase tension of brakeband by adjusting brake arm.

No erase, distorted recording. V4 EL84 oscillator stage failure. Check EL84, oscillator coil L4 and C19.

Distorted recording. Tape over-modulated due to incorrect use of record level indicator or failure of record level indicator EM34 or associate components.

Loss of H.F. response. Record-playback soundhead dirty. Remove ferrous-oxide deposit from gap of soundhead using carbon tetrachloride ("Thawpit") and a soft brush.

Loss of overall sensitivity. Insufficient tape pad pressure. Adjust tape pad springs.

"Squeal" from recording when rewinding or winding on tape. Muting contacts on tap deck operating switch not making.

Reservoir smoothing capacitor C16 is rated to handle 150 mA. ripple current.

Speaker is a 5 in. circular PM type.

Plessey

RADIO COMPONENTS

Variable Capacitors, Air and Compression Trimmers, Drives and Couplings, Vibrators, Chokes and Transformers, I.F. Transformers, Wavechange and Toggle Switches, Valve holders and Pilot Lamp-holders, Loudspeakers, Iron Dust Cores and Formers, Potentiometers, Cascap and Caslam Capacitors, Electrolytic Capacitors.

New Zealand Representative:

WILLIAM J. BLACKWELL

P.O. Box 1622. Auckland

EICOnomise - Buy EICO INSTRUMENT KITSETS

SPEED and PRECISION

TWO OF THE VITAL FACTORS IN THE MANUFACTURE OF COMPONENT PARTS! And two of the basic reasons why every day more and more manufacturers throughout New Zealand turn to us to supply their factories with parts.

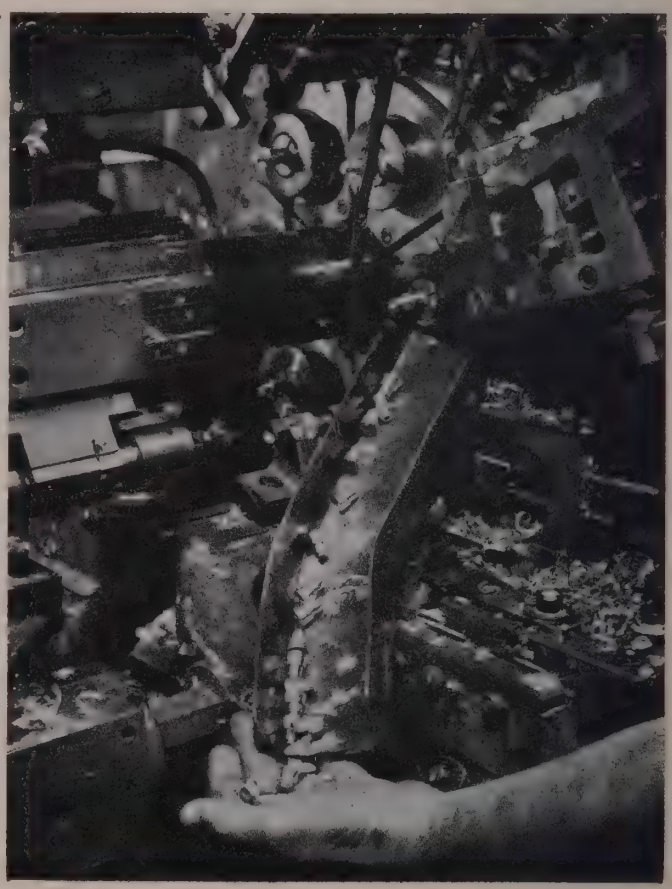
We have the modern machinery to mass-produce any part which can be made from stock up to 2¼ inches in diameter . . . we have the skilled technicians to guarantee perfect uniformity and accuracy . . . PLUS the organization behind both men and machinery to ensure that your order is fulfilled to your entire satisfaction and ON TIME.

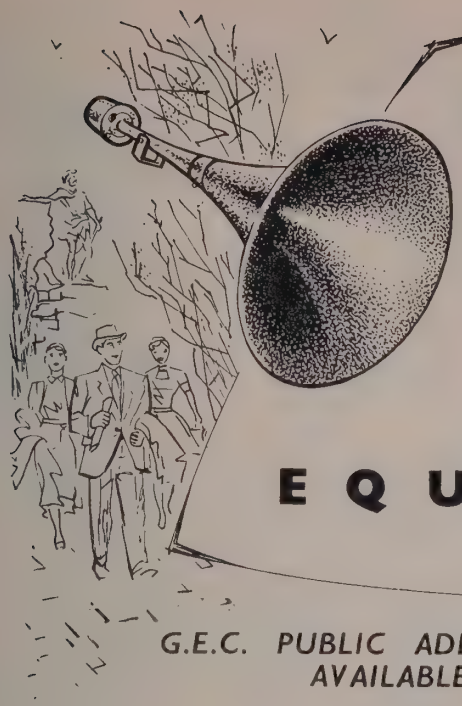
IF YOUR PROBLEM IS COMPONENT PARTS, YOUR SOLUTION IS . . .

AUTO MACHINE MANUFACTURING CO. LTD.

18-20 NELSON STREET, AUCKLAND, C.1

P.O. BOX 179. TELEPHONE 31-638





G.E.C. PUBLIC ADDRESS EQUIPMENT

G.E.C. PUBLIC ADDRESS EQUIPMENT IS NOW AVAILABLE IN NEW ZEALAND.

* *EX STOCK DELIVERY:*

10 Watt amplifiers.
20 Watt amplifiers.
30 Watt amplifiers.
Ribbon microphones.
Moving coil microphones.
Microphone stands.
Straight and re-entrant horn loudspeakers.

The G.E.C. "Senior" ribbon microphone head and the G.E.C. 20 watt mobile amplifier for A.C. main or 12V battery operation.

THIS EQUIPMENT HAS AN ENVIABLE REPUTATION IN BRITAIN & OTHER COUNTRIES IN THE COMMONWEALTH. WRITE FOR DETAILS TO OUR NEAREST BRANCH.

G.E.C.

BRITISH GENERAL ELECTRIC CO. LTD.

NEW ZEALAND SUBSIDIARY OF THE GENERAL ELECTRIC CO. LTD., OF ENGLAND

Wellington, Auckland, Hamilton, Napier, Christchurch, Dunedin, Invercargill.

N9.6

For every budget!
every kitchen!
every cooking requirement!

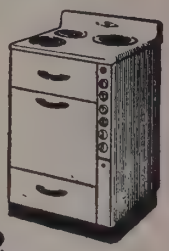
NEECO

Consort

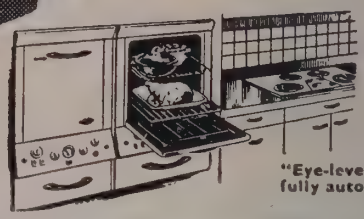
Low price, advanced features.

Sovereign

Medium price range, popular choice.



Ensemble



"Eye-level" cooking, fully automatic.

THE NATIONAL NEECO ELECTRICAL AND ENGINEERING COMPANY LIMITED

AUCKLAND – WELLINGTON – CHRISTCHURCH
DUNEDIN – HAMILTON – NEW PLYMOUTH
WANGANUI – HASTINGS – INVERCARGILL

Now available in New Zealand

EKCO LAMPS and TUBES

BRITAIN'S FINEST

they're better to see with

The complete range and types of EKCO Lamps, Fittings, and Control Gear, conform with the current British standards, and to the highest standards of efficiency and manufacture. . . . The perfect product of top British engineering.

NEW ZEALAND DISTRIBUTORS:

JOSEPH NATHAN & CO. (N.Z.) LTD.

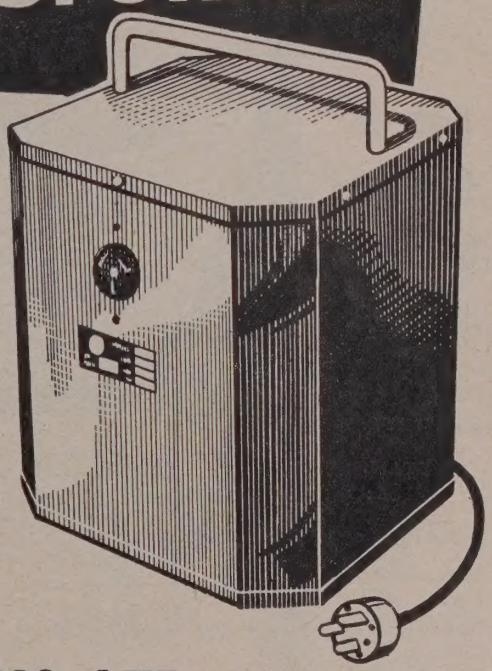
AUCKLAND : WELLINGTON : CHRISTCHURCH

for perfect safety!

ALL OUTDOOR ELECTRICAL EQUIPMENT

should have a . . .

BEACON *ISOLATING* TRANSFORMER



Make all electrical appliances SAFE — guard against fatal electrocution . . . with a Beacon Isolating Transformer. It renders all appliances harmless even if the frame should come alive. Sizes range from 250VA up to 3 KVA continuous ratings. Available in steel case, with carrying handle or with wall or floor mounting. Compound filled to prevent moisture absorption.

THIS ISOLATING TRANSFORMER COMPLIES WITH ALL STATE HYDRO REGULATIONS

BEACON RADIO LTD.

CORNER BROWN AND FITZROY STREETS, PONSONBY, AUCKLAND.
P.O. BOX 2757. —— PHONES: 14-704, 13-390.

Manufacturers of All Kinds of Transformers and Fluorescent Lamp Ballasts

It's here! NEW

FOOD CRAFTER

by Westinghouse

Now in Glorious COLOURS

PRIMROSE, PASTEL GREEN CORAL PINK, and WHITE.

RETAIL PRICE:

£21/5/-

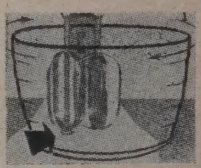
Optional extras: JUICE CRAFTER

(MEAT GRINDER available shortly).

The latest from Westinghouse, America, new FOOD CRAFTER far surpasses other conventional mixers in greater usability, mixability and power. FOOD CRAFTER bakes cakes lighter than a cloud . . . because the constant, even beating ensures a finer-textured mix. FOOD CRAFTER is styled to that American elegance which proves practical things can be beautiful and makes instant eye appeal to your customers. FOOD CRAFTER is as rugged as a work horse, power to spare for even the heaviest mix—no slow-down, no stop. FOOD CRAFTER Never NEEDS OILING . . . life-long lubrication is sealed in. Stock and recommend Westinghouse FOOD CRAFTER.

Thumb-tip Beater Ejector . . . just touch the button . . . and zipp, out come the beaters.

Mix Dial Up Front . . . swift—visibility of six basic speeds—plus twenty variations.



Merry-Go-Round Bowl . . . assures all ingredients are brought in to beaters for a complete mix.

Pitcher-type Juice Crafter . . . gets ALL the juice! Made of transparent plastic. Graduated in ounces.

YOU CAN BE SURE..IF IT'S Westinghouse

Available from **H. W. CLARKE [N.Z.] LTD.** Branches throughout N.Z.

TELL YOUR CUSTOMERS . .

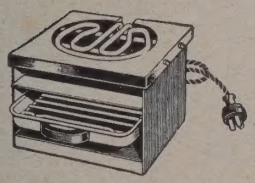
You can be sure of

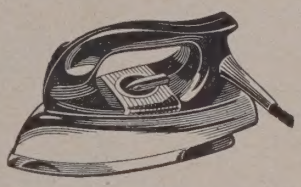
Quality

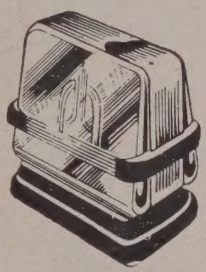
when you buy

Ultimate

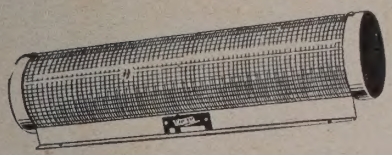
ELECTRICAL APPLIANCES

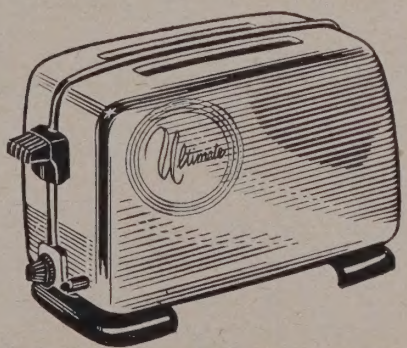




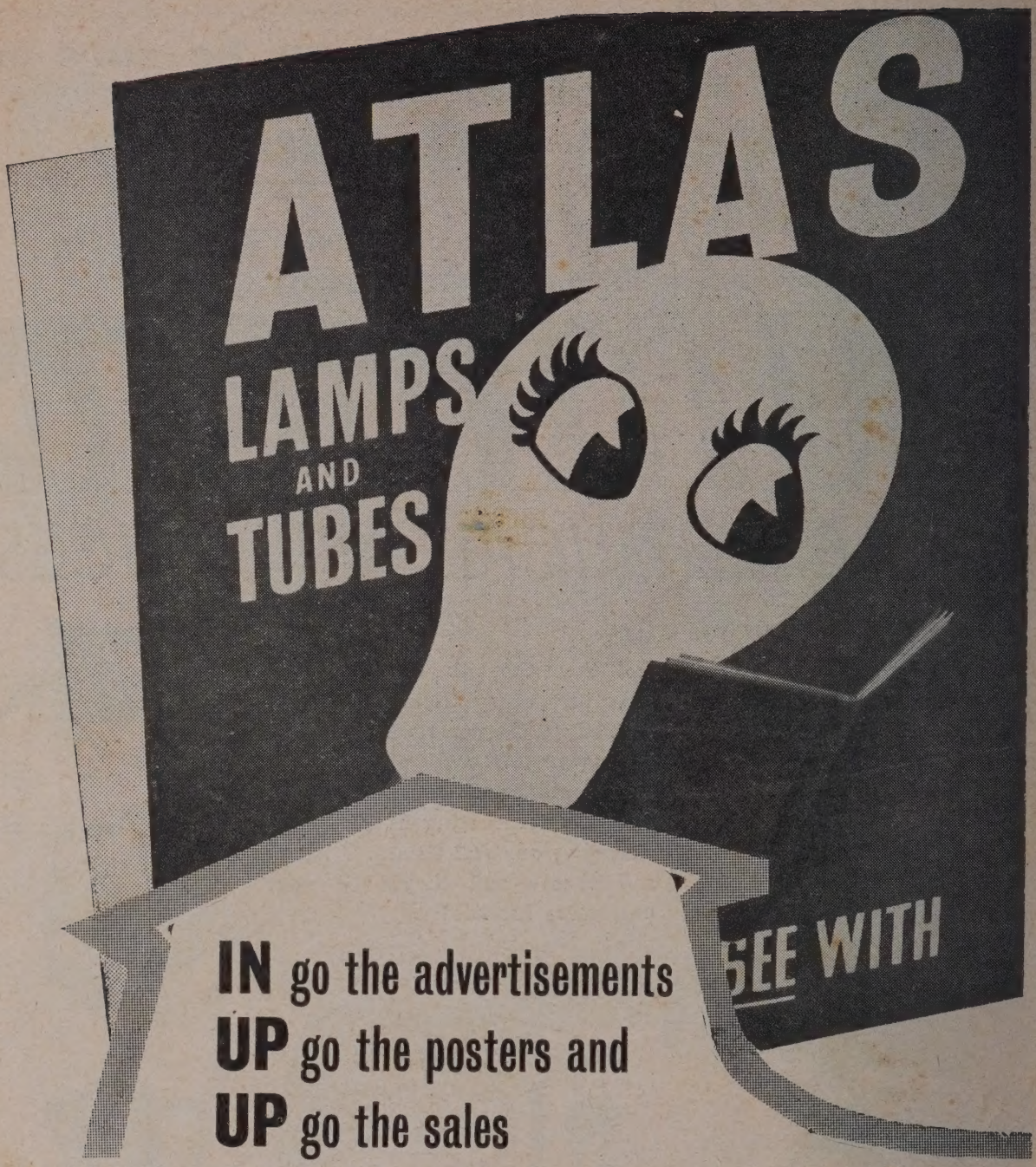


Tell them about the extra care that goes into *every* Ultimate product . . . about the non-rusting, longer-lasting metals used where corrosion could occur . . . about the final thicker coating of chromium that goes on. Tell them . . . then *sell* them — and they'll be your customers for life!





Quality Products of ULTIMATE-EKCO (N.Z.) CO. LTD. Quay Street, Auckland



IN go the advertisements
UP go the posters and
UP go the sales

Thorn

DISPLAY ATLAS LAMPS
PROMINENTLY IN YOUR WINDOW
AND TIE UP WITH THIS PUBLICITY DRIV

New Zealand Distributors:

K. SIMPSON LTD., P.O. Box 2498, Auckland
ARNOLD & WRIGHT LTD P.O. Box 2253, Auckland
and P.O. Box 6198, Wellington
EGLEY ELECTRICAL CO. P.O. Box 765, Wellington
ZONTILIER FLUORESCENT LIGHTING CO. LTD.
P.O. Box 5030, Wellington
THOMAS HYDE LTD. P.O. Box 503, Christchurch